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THE PROBLEM OF CONSCIOUSNESS

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For the past twenty-five years there has been a rising tide of discontent among psychologists with reference to that phase of the subject matter of their science termed consciousness. The reader need not be reminded of the long history of this term in man's reflective thought nor of its involvement with numerous philosophical problems not in themselves essential to a scientific understanding of human nature. Even in a treatise like Dunlap's 'Elements of Scientific Psychology,' where the author has made a vigorous effort to divorce his account from unnecessary speculation, the following quotation will indicate that most, if not all, of the ancient controversies, are present in condensed form awaiting only discussion and expansion in order to spread their blighting influence over the field.

"*Consciousness*, as precisely used in psychology, means merely *awareness* of something, and wherever we find the word *consciousness* we can substitute perfectly the word *awareness*. For instance: when I look at the page in front of me, the situation is expressed in part by 'I see the page,' or 'I am aware of the page,' or, 'I am conscious of the page.' Consciousness is neither the 'I' nor the 'page.' It is necessary to emphasize this, because much confusion has been bred on the point. There are three aspects of the situation involved: the *I*, the *page* which I see, and the fact of *seeing* the page. These three are not identical, although the situation is not complete unless all are present."

The author's exposition of this quotation is such a typical statement of the conventional point of view with which we wish to contrast the contribution of the present paper that we shall quote again from it and advise the reader to consult the passages in which the author continues his exposition.

"This total situation, in which there is conscious adjustment, is best designated by the term *experience*. When we consider in detail such a situation, in which we have experience, we find that there are four factors which are to be taken into account. Three of these factors are immediately given as essential parts of the experience, and the fourth is inferred or discovered as a condition of experience. These four factors are:

1. *Something* of which we are conscious. That 'something' is called *content*.

2. *Consciousness*, or *awareness* of the content.

3. I, or the *ego*, which is conscious, or has the consciousness.

4. Bodily or organic activity.

Physical science includes among its data only observable facts. Psychological science includes in addition two other facts, the second and third in our list above, neither of which are observable, but which are nevertheless empirical data, in that they are given in experience itself and are not inferences. The inclusion of these data is the only point in which psychology fundamentally differs from physical science, and if we ignore these data, we thereby abandon psychology completely, and go over to strictly physical science."[1]

Before proceeding with the exposition of our subject, it is important for the appreciation of the problem of 'consciousness' that we notice briefly the typical ways in which 'consciousness' has been treated in psychology. The structural psychologist has accepted 'consciousness' as a separate constituent or aspect of the universe coördinate with matter. Psychology becomes, then, the study of states of consciousness. As such there is no logical justification for the inclusion by the science of such fundamental material as behavior

[1] Dunlap, Knight, 'Elements of Scientific Psychology,' pp. 22–4.

offers, except in so far as these physical occurrences are accompanied by 'consciousness.' Such a view of psychology and its subject-matter was certain to produce revolt. The functional psychologists, strongly influenced by the Darwinian tradition and seeking to relate the two aspects of the 'psychophysical' organism, began the opposition by treating 'consciousness' as an instrument for environmental adjustment. Interest was now focused in this school upon the biological functions of the discriminable 'conscious' processes rather than upon the analysis of these processes into their irreducible elements and attributes. This point of view, however, still shared with structuralism the philosophical heritage of a divided universe composed of mind and matter, but it attempted to develop a scientific foundation for the belief which common sense had long held valid, viz., that mind or 'consciousness,' was other than an epiphenomenal manifestation in the universe. The third attitude toward 'consciousness' is represented by behaviorism as championed by Watson and Weiss. This point of view, recognizing the scientific undesirability of attempting to deal with such private ungeneralizable data as states of consciousness, which in addition were by definition alien to the world of observable environmental adjustment, solved its problem of the subject-matter of psychology by first ignoring 'consciousness' and at last by denying its existence. Here, then, are the three historical positions: (1) 'Consciousness' exists as a separate aspect of the universe, but it has no causal place in such a world. (2) 'Consciousness' exists as a separate aspect of the universe and enters into functional and causal relationships with the physical world. (3) 'Consciousness' does not exist, psychology thus applying itself to the study of behavior alone.

Our problem in the present paper is to seek another more acceptable position about which the various phenomena and points of view can be unified. The behavioristic position with its dogmatic rejection of 'consciousness' cannot finally prove acceptable. It is all but impossible to believe that observable data do not exist which have afforded the basis

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for philosophical speculation upon the nature of *mind*, the *psyche*, *consciousness*. Surely 'where there is so much smoke, there must be fire.' So long as the behavioristic position goes no further than Weiss even has done in his clearcut and incisive analysis of 'The Relation Between Structural and Behavior Psychology,'[1] so long will a large percentage of psychologists regard the program as inadequate. The data on 'consciousness' may be difficult to secure; they may be of no practical value when once attained; and their recognition may serve seriously to disrupt the causal sequence of science and thereby introduce mystery. And yet no mere denial of the existence of 'consciousness' can permanently win a wide following among psychologists. Weiss, in the article referred to above, speaks of conscious material as an unnecessary assumption added to the language report of the subject and therefore as something which may be dispensed with. His statement is as follows: "In other words, psychologists have agreed among themselves that an introspective report is more than a reaction; it is a verbal reaction plus some kind of a conscious process, which may be either sensorial, imaginal or affective. The behaviorist may well ask of what scientific value is this habit of supplementing, in a methodological sense, the observer's reaction by another reaction of an entirely different type (consciousness) which the observer did not report. By inferring a conscious correlate to the introspective report—the experimenter is not able to derive anything more from the report than is expressed in it. The manual and introspective reactions of the observer in a psychological experiment can be classified just as minutely and scientifically without inferring a conscious correlate, as they can with it." "The structuralist point of view can, of course, be consistently maintained. There is a justification for inferring the existence of a conscious correlate for at least some of our actions, but the heuristic value of this assumption seems doubtful when it is shown that behaviorism is not less discriminative or descriptive than structural psychology, and in addition it has the promise at least of a system whose parts are causally

[1] Weiss, A. P., 'The Relation Between Structural and Behavior Psychology,' PSYCHOL. REV., 1917, **24**, p. 307, 314.

related to each other in the sense that a temporal description of a given form of behavior is more uniform than the temporal description of the conscious states which are said to go with it. If this is true then the law of Parsimony will operate to eliminate the unnecessary assumption of a conscious correlate for behavior (implied by introspection)." Along side of these statements should be placed the following which Weiss makes in an article on 'The Relation of Functional and Behavior Psychology': "Consciousness and introspection to have any scientific value must be regarded as speech reactions which are restricted to the terms used in psychology."[1] This last statement I do not understand to supplant the former ones but to add to them the assertion that from a scientific point of view consciousness and the introspective report must be regarded as one and the same thing. The introspective report then becomes a minor reaction (to use Weiss's term) set off by obscure physiological changes in comparison with the main reaction which is determined by the experimental conditions, *e.g.* the response in a reaction-time experiment.

An opposing view, which I should like to set by the side of this statement of Weiss's, is found in Washburn's paper on 'Introspection as an Objective Method.' The reasoning is as follows: (1) The objective description of the stimulus-response situation makes no place for quality. Redness, *e.g.* is different from the stimulus and also from the response and yet it so certainly exists that the burden of proof must rest with him who denies its existence. (2) The certainty of the existence of 'redness' depends upon language behavior which reports the occurrence of that quality following upon a certain type of stimulation. (3) If we admit the reliability of a language report upon the presence of attributes of a present stimulus, then there is no sufficient reason for questioning its dependability when the stimulus is absent. Thus if a subject reports 'red' when affected by the proper stimulus, there is no good reason for questioning his testimony if, following a red stimulus, he reports the occurrence of a blue-green after-image. If, therefore, the reliability of a subject's

[1] 'The Relation Between Functional and Behavior Psychology,' PSYCHOL. REV., 1917, 24, p. 368.

report can be established where outside verification is possible (as, *e.g.* on the presence of over-tones or on the blurring of a visual object), the same subject's testimony may be accepted with reference to the presence of similar phenomena where outside verification is impossible. To one who grants the cogency of this reasoning, as I do, the need for further work in an effort to bring greater order in the psychological world is obvious. It is not sufficient to say, as Tolman does, that 'quality' does not get into the science, that only the verbal report gets there. Maze-running, selective reactions, the nature of atoms, and a thousand other things also do not get incorporated into science, and yet they exist. Science is made up of systematized (verbal) reports by experts, whether the field be psychology or physics. The great essential is that we recognize that certain behavior is not merely itself but that it is also a report of something other than the behavior—as the vocal response 'red' stands for or symbolizes, in the organism's own reaction history, something other than that response itself.

Can we secure an understanding of the nature of 'consciousness' which will conserve the interests of a scientific study of human nature? To do so we must work in the light of data gathered both by the behaviorist and the structuralist, and we must provide for both introspective and non-introspective methods. I say we *must* because it is unreasonable to suppose that keen minded scientists can be so far astray as the two schools think each other to be. What we desire is to fit consciousness into the general scheme of observable phenomena in a manner conducive to experimental and not merely to theoretical verification. The accomplishment of this is the only way in which dualism and mysticism can be excluded from the science. Only when the 'facts of consciousness' are included can agreement be reached between psychologists. This harmony is not sought for logical purposes but for practical experimental returns which are certain to accrue if the division in our understanding of psychology can be overcome. If it is at all possible, the answer to the question 'What is consciousness?' should be put as a formulation

of observable phenomena and not as a theory. By so doing, we may be able to avoid the interminable philosophical controversies which beset the subject.

Let us first present the observable phenomena which are to be examined and then proceed to the study of the adequacy of the resulting formulation. Language responses enter into a two-fold relationship with receptor and effector activities. On the one hand they themselves constitute an effector activity aroused by the stimulation of receptors and on the other hand they have as their consequents both receptor and effector changes. There is thus a verifiable two-fold relationship: on the one hand proceeding from antecedent receptor activity to subsequent language response and, on the other, from antecedent language response to subsequent receptor and effector process. Interest in the present discussion centers upon the first relationship. To the extent that one analyzes the latter, to that extent does he concern himself with the functions of the first receptor-effector relationship. Our formulation so far is in no way intended to prejudice the possibility of arousing language responses by means other than the stimulation of receptors. It is quite possible that neural changes not immediately and directly traceable to receptor activities may also condition the responses in question. This is a matter for experiment and experimentally founded theoretical analysis to decide. For purposes of exposition, however, it is well to limit ourselves to the well established case, viz., that where the presentation of a given stimulus with the instructions 'What is it?' is followed by a language response in an organism possessing: (1) a certain receptor capacity, (2) a certain habit history, and (3) language ability. No misunderstanding can, I think, arise with reference to item number one. By item number two is meant that the organism must have been trained to respond in what the experimenter regards as a relevant way when the instructions are given. (No one, so far as I know, has regarded this ability as unlearned.) Item number three calls for a more extended discussion. What are we to understand by 'language ability'?

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In the first place, let it be said, no particular value is attached to the term 'language ability.' This term seems to be the most suitable to apply to the experimentally verifiable phenomena which we are to analyze and describe. If the reader desires, he may call it anything else which he may wish, so long as he agrees with us on the general nature of the observable data. But to proceed. There is a form of behavior which possesses the following essential characteristics (among others), first, it is symbolic and, secondly, it can be reinstated by the organism at the proper time. Contrasted with this behavior is that typified by the usual stimulus-response situation. Here the behavior (A-behavior) is called out by an unambiguous situation involving the presence of the originally effective stimulus and, so far as the organism is concerned, the stimulus-response situation in no sense involves a symbol or substitute. The behavior which I have in mind may be illustrated by the knee-jerk, by the act of reaching for an object presented visually, or by a cat chasing a mouse. In these cases the stimuli are presented in a certain setting, which is also effective in controlling the behavior, and after a longer or shorter interval of time the response takes place. The form of A-behavior is universally present throughout the animal kingdom. The first form of behavior described (I-behavior) is, on the other hand, limited to a very small portion of the animal series. So far it has been demonstrated in adult and young humans, and perhaps in the following animals as well: chimpansees (by Köhler), dogs (by Walton), and raccoons (by Hunter). Search for it has been made without success in cats and white rats. This I-behavior is found in the successful performance of the delayed reaction experiment and elsewhere. It may help in our exposition to describe this experiment because of its bearing upon the discovery of language capacity and therefore of 'consciousness' in animals. Our exposition of the nature of 'consciousness,' it need hardly be said, in no way depends for its validity upon the truth or falsity of our interpretation of the delayed reaction.

In this experiment the animal is trained to make a response

R to a stimulus S, a response R^2, to a stimulus S^2, and a response R^3 to a stimulus S^3. The responses differ chiefly in the spatial direction taken, although they might be made to differ in other respects. The three stimuli differ in location. After these stimulus-response connections have been made, the subject is tested by presenting one stimulus, let us say S, by removing this stimulus, and then, after the interval of delay, by permitting the subject to respond in a situation where none of the three original stimuli are present but where all three of the original responses are alike physically possible. If the subject can make the response, R, the explanation can only lie in the development of a substitute for S, a substitute which functions in the absence of that stimulus. Furthermore, the substitute in order to control the response must either be present itself or some of its consequents must be present at the moment when the response is begun. The experimental conditions may be so arranged as to exclude the possibility of a substitute outside the animal, so that the successful performance of R is sufficient evidence of the development of a substitute within the organism. Thus far the reaction described does not differ from any habit-forming or conditioning process and as such has been demonstrated even in the rat. (The usual conditioned reflex is found as low as the snail and the earthworm.) The essentials of our type I-behavior are only added if it is possible for the substitute stimulus to disappear during the interval of delay and yet be revived at a time to condition the correct response. If the subject is thoroughly distracted during the enforced delay of the response, there is every reason to assume that the substitute has been displaced. If the correct response occurs, the substitute must have been present. Therefore where the correct response occurs after distraction during delay, the substitute process possesses our two characteristics of a language response, an LR symbolic character and reinstatability under the control of the organism, as opposed to reinstatement under the control of S, the original external stimulus or some external substitute. I have therefore called this substitute process an LR. It is a phenomenon whose occur-

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rence is experimentally verifiable. And, if our later formulation of the nature of 'consciousness' is correct, the present account makes it possible to indicate the presence of 'consciousness' in animals without depending upon such theories as that of evolutionary continuity or of the anatomical similarity of organisms.

The experimental search for the language process as just described can be and has been carried out upon man as well as upon the animals below him. With man other methods are also available. With the animals below him this is not the case because of the absence of gestural and vocal language. The reader will not, I am sure, confuse the vocal responses (the cries, moans and calls) of infra-human animals with the true language responses which we are discussing. These responses are no more language than is the knee-jerk or the protective wink reflex. We can illustrate what would be necessary for these responses to become language. Thus, moaning becomes a case of language activity only when it appears as a substitute for some other situation such as bodily distress and when it can be aroused (it would probably be correct to say *by* the organism) in the absence of its adequate stimulus, injury. Usually in man a social significance attaches to a language activity so that the response is a substitute stimulus for another organism's behavior as well as for the control of responses in the first organism. This would occur, *e.g.* if my moaning resulted in tender behavior of another toward me when there was no real bodily distress present to condition the moan. We need not, in the present discussion, attempt to decide whether this social status is always present in language or not. What we have said with reference to the vocal response of moaning is equally applicable to many vocal and verbal responses. Thus the responses 'red-white-and-blue' and 'a-b-c' are not necessarily language. They become such only if they function as substitutes whose revivability is under the organism's control. Hand movements may become language activities in the same way. And it is important to recognize that the same language characteristics may remain although the responses become slight and implicit.

Here, then, at the conclusion of this brief examination of language activity, we may repeat the statement first made that the presentation of a given stimulus with the instructions 'What is it?' may be followed by a language activity in an organism possessing: (1) a certain receptor capacity, (2) a certain habit history, and (3) language ability. This phenomenon is observable and verifiable and is typified in what we shall term, for convenience of future reference, the *Type-X situation, where the language response 'red' follows upon a certain visual stimulus and a certain instruction stimulus.* We must also call attention to our former statement that the Type-X situation contains an *LR* which follows upon a sensory process, *SP*, and also that the *LR* in turn leads into further receptor and effector activities. Thus the visual stimulus plus the 'instruction stimulus' is followed by the language response 'red' which sets up kinæsthetic auditory processes which *may* in their turn set up another response 'color.' So far, I believe, we are upon solid ground where agreement is possible.

Let us proceed to advance our problem by stating the main thesis to be examined in this paper: *The irreversible relationship SP–LR is the phenomenon termed 'consciousness.'* By being irreversible I mean that where *LR–SP* or *R* occurs we do not have a phenomenon termed 'consciousness.' Only the one way relationship is vital.

From now on we must consider the many phases of any attempted solution of the nature of 'consciousness' as a subject for scientific as opposed to philosophic study. During the discussion it will be interesting to note how many of the values which are claimed for consciousness will be conserved by our formulation.

Even with the subjective psychologist, 'consciousness,' for scientific purposes, has been intimately connected in one way or another with language responses, usually verbal in kind. (This we have already noted in the quotation from Weiss who is a behaviorist.) The following from Judd, who is a subjectivist, will indicate the truth of our statement for this group of psychologists.

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"The inquiry is involved at this point in a perplexing circle. Human mental processes as we know them are intimately related to language. Even when we think about our most direct experiences, we use words. When we enlarge our associations, we usually do so with the aid of words. Yet these words do not seem at all explicable except when we assume complex ideational processes as the necessary conditions for their development and interpretation. Did human mental advance result from the development of language, or did language result from the development of associational processes? The only answer to this question is to say that language and ideational processes developed together and are necessary to each other. So long as animals were absorbed in direct responses to the demands of their environment, their mental complexes were of a direct, primitive type, and stimulations issued into direct motor channels with relatively little possibility of ideational organization. As soon as a type of response developed which was indirect, there was a complete change in the general mode of bodily and conscious organization. . . . Thus, if one has different names for two objects which resemble each other closely, he will be aided in discriminating them through the use of the different verbal reactions to them. Speech is, accordingly, both a product of ideation and an aid to its development."

"If it is true in a general way that general tendencies of thought have been dependent upon the development of words to express ideas, it is still more true in the case of the individual that his mental tendencies are very largely determined by the forms of social thought expressed in words. A child who has had his attention called to certain colors and who is, at the same time, given a name for these colors, is more likely to identify them in later experience than if no name had been given. The name serves as an incentive to the concentration of attention upon a particular phase of experience which would otherwise be lost in the general mass of sensations. Without the word, the possibility of dwelling upon the single phase of experience in thought would be small. This is the reason why the retention of facts in memory is so closely

related to the naming of objects. Some experimental evidence can be adduced to show that names are of great importance in this respect. If one is confronted with a large number of pieces of gray paper ranging from black to white, and is asked to discriminate as many of these different grays as he is able to recognize with certainty, it will be found that he can distinguish ordinarily about five classes of gray shades. . . . If, now, after making this test under ordinary conditions, the individual is allowed to examine the various shades of gray and to adopt a series of names or numbers for them, it will be found that he can notably increase the range and certainty of his discrimination. The names furnish, as stated above, definite means of concentrating attention upon slight differences which existed from the first, but were not noted in experience." [1]

During the preparation of the present paper an article on the nature of 'consciousness' has appeared in this journal by K. S. Lashley. Lashley gives a very keen presentation of man as a machine and concludes as follows: "The conception of consciousness here advanced is, then, that of a complex integration and succession of bodily activities which are closely related to or involve the verbal and gestural mechanisms and hence most frequently come to social expression." And again, "The relation of any integration to the speech and gestural mechanisms is of prime importance for its 'conscious aspects.' Not only is the single certain evidence of consciousness in another person the existence of consistent, rational expressive movements, but the introspective evidence that there was consciousness at a given moment consists in the occurrence of thoughts (verbal or gestural sequences) conditioned by the state at that moment. The core of the 'conscious' integration is the verbogestural coördination."

We find with Lashley, therefore, as with Weiss and Judd, an appreciation of the close relationship between 'consciousness' and language responses, but we do not find an analysis of that relationship. With so very general a conception of

[1] Judd, C. H., 'Psychology,' 1907, p. 253 and p. 260–1.

[1] The Behavioristic Interpretation of Consciousness, I and II, PSYCHOL. REV., 1923, 30, 341 and 342.

'consciousness' as that presented in the first quotation from Lashley, it is difficult to work. Which 'complex integration' of bodily activity is to be the equivalent of 'consciousness'? Does this 'complex integration' continue to appear in an hysterical subject and, if so, how is its presence determined? How is it related to the process of habit formation in order to care for the relationship which is asserted by many to hold between 'consciousness' and the increasing integration of acquired responses? How shall we formulate the phenomena covered in the view that 'consciousness' is an instrument of adjustment possessing greater effectiveness than 'instincts and habits'?

My chief objection to Lashley's position is its indefiniteness. Furthermore, I am sorry that he stresses the physicochemical theory so much. In the first place, this antagonizes many psychologists who do not like the *philosophy* of the 'man-machine.' In the second place, the physicochemical theory is one concerning the ultimate explanation of behavior and not one descriptive of the subject-matter of psychology. I see no reason why psychologists should be asked to commit themselves to such a theory at this early date. We are studying such phenomena as the learning process, or discriminative reactions, or performances in 'intelligence' tests. What we need in the field of explanation for a good many years to come is a close adherence to empirically derived data rather than loyalty to a possibly ultimate physicochemical goal.

I should like to record here my complete agreement, however, with what Lashley says on pages 346–7 concerning 'Valuation *versus* scientific description.'

In seeking empirical justification for our thesis, let us examine first the problem of the lower limen of sensitivity to contact. The untrained subject, we shall assume, only gives the language response 'contact' or 'yes' to a stimulus of number 5 intensity. This connection between stimulus and response has been set up at some prior time in his life history. Anything less than 5 is subliminal, or outside of 'consciousness.' Now with training, where the same response is called

for with lower intensities of stimulation, it comes about that the response is given to intensity 3. It is now said that the limen has been lowered and that 'consciousness' occurs where it did not before. Let us suppose that extended training fails to establish a connection between the response and an intensity below 3. Three now is termed the psychological threshold. Intensities between 3 and 1, let us say, will be followed by certain responses, *R* (circulatory, *e.g.*), and so intensity 1 is termed the physiological threshold. It is said that the two thresholds cannot be made to coincide. The objective criterion of 'consciousness' is here the language response. The equivalent of consciousness is the Type-X situation here presented. This result of our analysis leads at once into observational and not merely into theoretical work because it now becomes a real experimental problem to determine how faint a stimulus may be and yet determine a language response. Wherever such a situation is found, there we have a 'state of consciousness.'

Let us take as a further illustration the discrimination of overtones in a clang. The beginner in the psychology laboratory does not hear these overtones, although physics can demonstrate that correlated vibrations exist in the stimulus. The subject is not 'conscious' of the tones,—at least he makes no verbal report of their presence and for scientific purposes he is said to be unaware of them. The experimenter now presents the vibration frequency of the first overtone (*SP*) by itself. This stimulus elicits response *LR*. *SP* is then presented as a part of a complex stimulus in order to see whether or not the same response, *LR*, will now appear. If it does not, the training is continued. *Just as soon as the verbal response, LR, is made to the complex stimulus, just so soon does the subjectivist say that the 'consciousness of the overtone' is present.* Again we have a case of the Type-X situation. Why do we not say that *LR* is the subjectivist's 'consciousness' and not merely a criterion of its presence? Because *LR*, if it is to be rated as 'conscious,' must in its turn have a language response conditioned to it and so be the *beginning* part of a Type-X situation. Only in the irreversible situation do we

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have 'consciousness.' It now becomes a fertile field of experimentation to determine what stimulus aspects may be determiners of language responses and not merely of non-language responses. The irreversible relationships between these stimulus aspects and the language responses will then be 'states of consciousness.'

We have chosen the two cases of the lower limen of sensitivity and the discrimination of component aspects of a complex situation, as the most vital aspects of adult human nature upon which to base our formulation, for a very definite reason. If it were possible we should follow the truly genetic method in the establishment of our thesis as well as in its application. There are, however, no well established facts concerning the 'consciousness' of infants and children, so that we must of necessity test our conception upon adults. When, however, we examine that situation at this age level, it is found that the phenomenon termed 'consciousness,' although very generally conceded to exist, is very complex and has a long history in the individual's lifetime. We must therefore select for analysis the most definite, least ambiguous, and most experimentally inviting of the instances where 'consciousness' is extended or where new 'consciousness' arises. Having arrived at our formulation upon this basis, its adequacy—and therefore, its truth—can be tested by examining its harmony with certain accepted data gathered from adults, children and infra-human animals and by observing the extent and vitality of the experimental implications of the conception.

In the two fundamental cases of conscious limen with which we have dealt, nothing has been found which does not come under our formulation. These cases, while convincing, may nevertheless not be thought crucial. If so, then the critical case for the formulation is the following: Can a receptor which does not normally condition 'consciousness' be made to do so? Stated from our point of view as a matter for scientific verification: Can activity in a receptor which does not normally condition a language response be made to do so by training? To be sure we have almost shown that

this is possible to a limited degree, for the so-called subliminal receptor activities do not normally condition language activities. Perhaps the really crucial case comes with receptors all of whose activities psychology now treats as permanently subliminal to 'consciousness.' Can the receptors in the viscera which do not condition 'sensation' be made to do so by training? Only positive results can be crucial, *for the everyday training of the subject may have resulted in connecting with language responses all of the different kinds of receptors which it is possible to connect.* All that training may be able to do may be of the order discussed above. This, however, is a matter for experiment and not for theory to decide.

The experimental fruitfulness of the Type-X formulation is by no means exhausted in the above instances. Are verbal language responses the *LR*'s most readily connected with neural conditions? Are there implicit language responses which are even more sensitive? Experiment can and will undoubtedly answer these questions. What is the extent of the Type-X situation in the animal series? What is its natural history in the individual? The older students attempted to proceed by analogy and by philosophical theory to determine where 'consciousness' was present. The present method of approach contains as much analogy as and no more than is involved in the study of the appearance and mode of change of the air respiratory apparatus in animals or in the determination of the presence and development of walking activities in the child. The present formulation does not use the terms (or derivatives of) mind and matter and is no more concerned with philosophical questions than is the problem of the mechanism of heredity in the science of biology. And yet if what we have presented is true, then philosophy will use it and argue about it, because a part of the business of philosophy is so to treat the fundamental aspects of the sciences. These philosophical controversies need not, however, distract us from the chief business of the day any more than similar ones distract the biologist and the physicist.

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So far our account has been in terms of peripherally initiated neural processes (*SP*) whose stimuli can be controlled by the experimenter. This is the all important field in which to meet our problem first. Classical psychology regards the sensory processes ('sensations') as the originals of knowledge, and images as their derived copies. If our account of 'consciousness,' therefore, is adequate in the field of sensation, we may proceed without undue hesitation into the less accessible field of images, thoughts and feelings. I can imagine the structuralist admitting the truth of our Type-X formulation in the fundamental case of the establishment of a lower limen of sensitivity and yet insisting that 'over and above' or 'in between' the elements of the irreversible relationship is to be found a 'consciousness' which *is* the sensation. Indeed he might claim this and still be willing to admit that the present formulation is one way of describing the neural conditions accompanying 'consciousness.' My reply to this is as follows: Nothing is found in the Type-X situation other than the establishment of the irreversible relationship. If scientific observation can find nothing else, then the assumption of the existence of a 'state of consciousness' over and above that of the irreversible relationship is not justified unless such an assumption is forced by experimental findings. If one billiard ball strikes another, we are not justified in assuming the transfer of a force, or the presence of electrical changes, or the interpolation of a totally different spiritual substance unless experiment points to this. Nor need we assume the presence of a devil in a knife merely because we are injured by the knife. The 'consciousness,' however, which the psychologist-philosopher has believed in is said to be an observable something and not a thing which must be inferred. And we insist that we are unable to find any observable *extras* in the irreversible relationship described.

What reply shall we make, however, to the critic who suggests that in the experiment upon the lower limen of sensitivity, consciousness first appears and is then reported by the language response? We shall first hasten to concede that 'consciousness of the contact' may be reported as having

been present at a time when no overt language behavior was observed by the experimenter. There are several possible explanations or descriptions which may be given of the problem raised by the critic's question: (1) 'Consciousness,' in the conventional sense of that word, may have been present. (2) A language response non-observable by the experimenter, but nevertheless a genuine motor response of the language type, may have been present. And (3) some neural process controlling, or physiologically equivalent to, a language response may have been aroused by the sense organ stimulation without, however, leading at the time even to an implicit *LR*. We should be guided in our choice of the probable answer to the question by the scientific adequacy and fruitfulness of each possibility.

To accept number one is to be plunged back at once into all of the interminable controversies from which we are seeking to escape. This explanation, therefore, should be chosen only if some other better one is not forthcoming, one which not only will help us avoid controversies and which will lead us to an experimental attack upon our problem of human nature but one which will not violate the law of parsimony by introducing a multiplicity of causes one of which is of a totally different order from the others.

With reference to explanation number two, it can be shown, and it is generally admitted, that language responses may be detected which are not overt and which are not open to ordinary external observation. If this is true in many cases, it is more reasonable to assume that it is true in all cases and that future experimentation of a more refined character will verify the hypothesis than it is to assume the existence of a different aspect of the universe as one of the several phenomena present. However, even if future experimentation never reveals such responses—and as a practical matter, of course, it cannot do so for every case which occurs—the third possible explanation is not to be ignored. This third hypothesis does not contradict any known physiological law, and it is in harmony with much current neurological speculation. It might conceivably be experimentally justified beyond

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doubt. This third hypothesis calls attention to the possibility that the effects of previous *SP–LR* relationships may be conserved in the nervous system and so be involved in present activities as the essential equivalents of the original relationships. It is generally agreed that practice effects are retained throughout the field of stimulus-response relationships and that, being retained, they become integrated with subsequent relationships. There are also demonstrable effects upon behavior of 'the instructions given the subject' which lend color to the theory of a 'cortical set' which aids in the regulation of responses. The third possibility which we are discussing invokes a phenomenon of this general type. It assumes the retention of the *SP–LR* relationships in neural terms. However, it is not so acceptable as hypothesis number two because from the nature of the case it is always less observable than an *LR* and is therefore less open to verification.[1]

Once the irreversible relationship *SP–LR* has been established, it may be latent or active depending upon a variety of physiological factors. Only when active is the 'consciousness' present. Let us illustrate: An American flag is shown. The subject is 'conscious' of the flag if the flag stimulus arouses a language response. He may be 'conscious' of the

[1] Psychology, in the major portion of its experimental and observational work, has not concerned itself with neural processes. Only in theory and in attempts at explanation has it done so. These efforts, we may concede, have had important effects upon the interpretative points of view adopted by individual psychologists, but here their value has largely ended. The sufficient refutation of the statement, if I may put in a word in defense of behaviorism, that behaviorism is physiology lies in the comparison of physiological and behavioristic studies. Watson does not even include Sherrington's work and I believe makes no mention of Loeb in the 'Psychology from the Standpoint of a Behaviorist'! *Of course*, some day behaviorism and animal psychology in particular may be nothing but a science of 'muscle twitches,' but the subject has yet to start in that direction, if its present status is judged by the experimental work which is being done. So Dunlap's statement, which we have quoted, that without 'consciousness' and the 'ego' psychology reduces to physical science is also experimentally unjustifiable. We are not concerned with philosophical distinctions between the sciences. Psychologists are studying phenomena which no other group of scientists is attacking, and to call the phenomena psychical or physical does not advance the study. We are looking for verifiable data of an experimental character on human nature. What we are called makes little difference. Academically we are at present known as psychologists, but we need not therefore be prepared to die in defense of the 'psyche' in our name!

flag and not of the red in it. He becomes 'conscious' of the red, *i.e.* he discriminates or separates out or attends to the red, when the red stimulus evokes an *LR*. This can be verified by non-experimental procedures or experimentally in the tachistoscopic type of observation which, *so far as it is a study of 'consciousness,'* is a study of the establishment of *SP–LR* relationships under certain temporal conditions. Let us examine one further case: A light ray, 660 $\mu\mu$, stimulates the subject's eye. The subject speaks the word 'red' under the additional control of the *Aufgabe* 'What is it?' Now of what was the subject 'conscious'? Our answer is that wherever the irreversible relationship *SP–LR* occurs there is 'consciousness.' Thus if the word 'red' were a language and not a mere verbal response, 'consciousness' would be present. The structuralist would say that at that moment the subject was aware of a 'red quality.' Note, furthermore, that according to our position as well at according to that of the structuralist's, the subject may not have been 'conscious' of the response 'red.' He becomes 'conscious' of his *LR* only when it in turn evokes a report, *LR*. Granted this, then the 'consciousness of the red quality' does not describe the simple *SP–LR* situation but does describe the complex irreversible relationship *(SP–LR)–LR*. In other words, there is in all probability an implicit language response involved, although there may be only its cortical equivalent as indicated on page 19.

If scientific record is to be had, of course, at least one of the *LR*'s must be explicit. This *LR* may be one of which the subject is 'unconscious,' *i.e.* one of which he can make no subsequent report, and yet it may be in the form of writing and so remain, after the disappearance of the 'consciousness,' as an indicator to the world of science of the presence of the Type-X situation.

How can we detect the presence of the irreversible relationship *SP–LR*? This question must be answered both from the point of view of the experimenter and from that of the subject. As the first prerequisite, from the former's point of view, the possibility of the existence of *LR*'s must be estab-

lished for the particular subject concerned. This can be done as we have noted. The experimenter may then observe the clinical picture presented by the subject and thenceforth assume the presence of the relationship whenever that clinical picture is presented. It is thus that he distinguishes between the 'conscious' and the 'unconscious' conditions of individuals, between one who is awake and one who is asleep, between one who 'knows what he is doing' and one who does not, between one who is under an anesthetic and one who is not, etc. But the individual possessing language capacity may nevertheless not have the *LR* set up by any and every *SP*. The extent of this conditioning must be experimentally determined. In man, processes in the retinas, cochleas, olfactory membranes, etc., may certainly condition an *LR*, the static sense cannot probably, receptors in the heart probably not, etc. With raccoons, it is possible that the eyes can condition an *LR* and that experiment might indicate that no other process could. If the experimenter's study of 'consciousness' is to be scientific as opposed to practical, he must be prepared to ask constantly whether or not the criteria of language are fulfilled by the response. He must not merely rely upon his clinical picture of whether or not the subject is awake and 'attending to business.' The regulation experimenter upon 'consciousness' assumes, on the basis of common sense, that the subject *is* 'conscious' at the time of the experiment and then proceeds to take the subject's report of his 'conscious processes.' It would be worthwhile to return to this point in an account of introspection. And in such a discussion we should be interested in the warrant for assuming that the subject's report is really a report upon his 'conscious processes.' For the present, however, it is necessary to ask ourselves how the *subject* detects the presence of the irreversible *SP–LR* process. This, from the point of view of the subjectivist, is one of the most important questions which we could undertake to answer.

A great many processes occur within the organism, many of which are under the control of the nervous system. Of these latter, some are ordinary stimulus-response processes while

others we have called *SP–LR* processes. How does the organism, the subject, know the *SP–LR* process? We cannot admit that an 'awareness' or 'knowledge' accompanies this process, or is inserted in it, unless we are prepared to recognize a separate aspect of the universe, the 'conscious aspect' of the structuralist. Our present problem, then, concretely put is this: Light of wave-length 660 $\mu\mu$ stimulates my eyes and I say 'red.' The response we shall assume is an *LR*. It is, however, ridiculous to suppose that before 'I know that I am aware of the red' or that before I can manifest an *LR* I must know the essential criteria of an *LR*. This is no more true than it is that I must know the nature of an instinct before making an instinctive response. The external observer, it is true, must know the criteria of an *LR* before he can assert that I am 'conscious,' but *I* report at once 'I see the red' or 'I don't see the red.'

Let us seek the answer to our question in the following manner, keeping as close to observable data as we can: (1) The Type-X situation is fundamentally different from other connections in the organism in the sort of adaptive value which it possesses, involving as it does a symbolic element. (2) It is the situation making possible communication between individuals and is, therefore (3) that phase of the individual which becomes organized primarily with reference to the *LR*'s of other individuals. By point number three, I wish to indicate that education almost if not exclusively concerns those processes which may be conditioned to language responses. (4) The so-called conscious personality is made up of the highly complex integrations of the Type-X situations. (5) It is to be noted that as I master language, I learn to apply the term 'conscious' to any situation in which these verbal responses occur. On the basis of common sense, 'consciousness' is a much larger phenomenon than it is on the basis of science. The social environment has not made a separate aspect of the universe out of certain stimulus-response relationships and made another aspect of the universe out of certain other stimulus-response relationships. Rather it has attached the response 'being conscious' to a hetero-

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geneous group of situations involving verbal and language responses. It remains for the laboratory procedure of the structuralist to insist upon the technical use of the term 'consciousness' to cover only the phenomena of our Type-X situation. Popularly the words 'I know where he is' and 'I remember his name' indicate 'consciousness.' Technically, however, before the subject can truly say 'I am conscious of so and so' he must be taught to apply those terms only under certain conditions, the nature of which he must largely figure out himself upon the basis of his reading and laboratory suggestion. The result is that the subjectivists are not agreed upon the means of identifying 'consciousness' and so recognize a 'stimulus error.' Our presentation, however, has taken the typical situation where 'consciousness' is said to be and has formulated it in verifiable terms which puts the situation within reach of experiment.

Except so far as it is desirable to use the term 'consciousness' technically, we can add the following account to what we have already said on the question, How does the subject identify that which is 'conscious'? *'I' and 'I am conscious,' being verbal responses* (sometimes of the *LR* type), *are caught in the vicious circle of the verbal response, i.e. they can be conditioned only by such processes* (*SP* processes or other verbal processes) *as can condition verbal responses.* Wherever they occur we have the popular 'consciousness.' But to ask why we are not 'conscious' of the heart beat or of the pupillary contraction is to ask why the receptor processes which arise there cannot, or do not, condition these responses. When I say 'I am not 'conscious' of the heart beat' I report the inability to have an *LR* or a merely verbal response conditioned by that particular activator process. Where a verbal or a language response appears, there I report 'I am conscious.' Where it has not been established, there I report 'I am not conscious.'

The functionalists have given an account of the life history of 'consciousness' which has been widely accepted. This account contains some important truth requiring our consideration, and we shall summarize it as follows: 'Con-

sciousness' appears when habits and instincts fail to adjust the organism to its environment. Consciousness disappears when the conflict, or problem, disappears, *i.e.* when the habits and instincts are again able to care for the organism. Something like this certainly occurs. We find Wundt and his disciples recognizing it in their accounts of the genesis of instinct and of derived action. 'Consciousness' is generally said to be markedly present when a new problem for habit formation is set and to be less and less present as the habitual activities become more and more automatized. Our account in the present paper recognized this when it was pointed out that the response given might be a language response in appearance only. We must now direct attention specifically to the life history of the irreversible *SP–LR* relationship and note how closely it tallies with the similar account given for 'consciousness.'

Let us use as our clearest and least ambiguous example the appearance of consciousness which comes with a lowering of the psychological limen of sensitivity. *SP* is repeatedly given in an effort to associate it with *LR*, the word 'contact,' *e.g.* or the word 'yes.' Here is a problematical situation in which the subject may be 'acutely conscious,' but not 'conscious' due to a lowered limen. When the *SP–LR* relationship is set up, or to the degree that it is set up, that which the subjectivist calls 'consciousness of contact' is present. If now the problem is too much overlearned, *LR* may follow *SP* so automatically that it is reduced from a case of I-behavior to one of A-behavior. Concurrently, the functionalist says that 'consciousness' disappears. The verbal response now occurs so invariably and so certainly that it is no longer any more a language response than is the knee-jerk. No experimental evidence has been gathered to show at what stage in the learning process this phenomenon occurs. The experimenter can get at the facts partly in a qualitative manner in terms of his clinical picture of how the subject behaves and partly in terms of the subject's report. In the latter case if the apparent Type-X situation can in its turn be connected with another *LR*, then the experimenter concludes that his

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subject was 'conscious' and was not merely responding automatically. In other words one check which we have upon the true language character of a response is whether or not it can be related to another response which the experimenter is willing to assume is a true *LR*. Ordinarily the situation is handled to the satisfaction of the layman. There do occur times of difficulty, however, even for him, when it is all but impossible to determine whether 'consciousness' is or is not present. I have in mind here, *e.g.* the case of an individual talking and answering questions in his sleep. Again, one of the most baffling questions of recent psychology has arisen out of the difficulty which we are now describing. Is 'imageless thought' a state of 'consciousness' or is it the absence of 'consciousness' due to the automatic way in which answer follows question? The experimenter cannot be certain, for although his subject may talk at length about the situation, it is practically impossible to determine whether the word responses are determined by the 'state of consciousness in question' or by 'other states of consciousness' or even by other behavior of the A-type after the pattern of a chain reflex.

We shall be helped in our understanding of the present formulation of 'consciousness' if we discuss briefly one specific problem of psychology. (The limitations of space make if impossible to discuss more.) We shall choose the problem of the distinction between instinct and emotion.

Diverse as are the various definitions of the terms instinct and emotion, there is a very widespread agreement that the two phenomena are closely related. Emotion is said by many to be the 'conscious,' or subjective, side of certain inherited responses termed the instincts. If an individual is angry, he experiences the emotion of anger while the outside observer can note only the instinct. To be sure, not all instincts are accompanied by emotions, but all emotions have an instinctive correlate. Such an account, however, is defective inasmuch as the subjectivist who gives it usually feels that he must ignore the instinct, the observable behavior. He therefore tends either to define the instinct in terms of some mystical purposiveness or else to treat only the general ques-

tion of the relation of instinct to 'consciousness.' Watson, on the other hand, refusing to admit the existence of 'consciousness,' defines the emotion, as well as the instinct, as a pattern reaction. The distinction between the two is then said to be that the responses in the case of emotion terminate within the organism while those of instinct terminate without. Such a statement of differences does not commend itself as significant. Only by a violent change in the meaning of the terms, can striking, trembling and running be excluded from the category of emotional seizures. And certainly the student of 'consciousness' cannot be expected to lend his support to such a view which excludes or denies the very aspect of the phenomenon in which he is chiefly interested.

From the point of view of the present formulation, the relationship is as follows: Certain stimulus-response relationships occur which neither involve language activities at the present time nor which may involve such activities in the future, adrenal gland secretions, *e.g.* To the extent that the associations are unlearned, to that extent are the responses to be called instincts. Other bodily disturbances such as the facial responses in anger, although constituting instances of what we termed type A-behavior, may be connected with language responses so that the total situation $(S–R)–LR$ becomes an example of the Type-X situation and therefore of 'consciousness.' Where this particular Type-X occurs, we say that the subject has discriminated, or become 'conscious' of, the facial responses. In the study of emotions we deal, conventionally, only with Type-X situations where the R in the total situation is the result of an unlearned association with S. Now it happens that in the typical emotional seizure, the stimulus-response activities are so complex that few specific and detailed LR's arise. (This is also favored by the type of training to which the organism is subjected.) The result is an irreversible $SP–LR$ relationship where the initial term is almost a total bodily disturbance. This Type-X is therefore the 'total feel of the emotion.' We may therefore say that *wherever type A-Behavior occurs there we have instinct and that wherever certain A-Behavior occurs as the antecedent*

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and an LR as the consequent, the resulting Type-X situation is emotion. The qualifying adjective 'certain' is introduced in this statement to care for what seem to be the facts, viz., that certain A-Behavior, such as play, does not have an accompanying emotion.

The formulation which we have offered for instinct and emotion must be varied as experimental evidence is secured necessitating such revision. It need not be varied because of shifts in philosophical bias and in the emphasis upon 'consciousness' which occur from one psychologist to another. Our account opens up a legitimate field for experimentation in the study of the distribution of *LR* associations in the field of A-Behavior.

What shall be said about the 'function of consciousness'? It will be remembered that the functionalist regards 'consciousness' as an instrument of adjustment, serving to adjust the organism to its environment when instincts and habits fail. We, ourselves, and many others hesitate to agree with this statement because of the very obvious interactionism which it assumes between two radically different aspects of the universe. The present answer to the problem carries us back to that of the life history of the Type-X situation which has already been discussed in this paper. We must now indicate the function which it serves during this history. First, it enables the organism to adjust itself in a selective manner to stimulating conditions which are absent at the moment of response. The irreversible *SP–LR* relationship thus does things or controls behavior or adjusts the organism, whichever way one wishes to put it, in ways that are impossible for instincts and habits (A-Behavior). Observation, both by the subject and by the experimenter reveals that this irreversible relationship appears in profusion when the automatic forms of response 'break down.' When it appears, successful adjustment is often facilitated by very virtue of the peculiar function which is inherent in the Type-X situation. There is interaction here, but it is an interaction of the same general nature as that between one bodily process and another. It is not an interaction which conduces to speculation and obstructs the progress of scientific observation.

What has been described is the general function of the irreversible relationship. It is possible that different specific functions may be found for different sub-classes of 'consciousness.' However, as I read present-day experimental work, I can lay my hand upon no well defined functions peculiar to this process as opposed to that process which can be accepted as probably established.

'Consciousness' formulated as the irreversible *SP–LR* relationship is therefore not a devitalized affair but is a process whose active participation in the life-processes of the individual is assured, indeed is assured not only in general as is that of type A-Behavior, but in particular as a unique relationship involving substitute processes which make the individual to a large degree independent of his present ostensible environment. It is the scientific equivalent of the philosopher's 'consciousness' and leads the way into fruitful experimental fields and away from unsolvable paradoxes.

One more question before we conclude: Is it possible, and then is it desirable, to have a science devoted and limited to a study of the Type-X situation? Since the irreversible *SP–LR* relationship is a verifiable phenomenon, the reply must be that it can certainly be studied and that a group of men can attempt to devote themselves exclusively to its study. However, although this attempt at an *SP–LR* science is possible, and indeed has been made by the subjectivists, it is an unwise and undesirable effort. It is unwise, in the first place, because the Type-X situation is not a process set off by itself, to be studied in isolation, but is one element in a vital integrated complex of observable behavior. As a stimulus-response relationship which is extremely complex as well as late in appearance in the animal series, it can be better studied when put in relation to its genetic setting than when taken by itself and treated as a reporter of an ineffable aspect of the universe whose existence, let it be noted, we have been unable to verify over and above the irreversible *SP–LR* relationship. In the second place, it is often impossible to decide whether the specific stimulus-response condition under observation is of the Type-X class or not. Thus while our

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conception makes possible the formulation of new modes of experimental attack and while it throws new light upon old procedures, nevertheless even our formula cannot make the study of the Type-X situation as simple as that of other stimulus-response relationships. Our exposition has already called attention to this difficulty. But if certainty of the presence, in any specific instance, of the irreversible *SP–LR* relationship is often an illusive and baffling goal, it is not different when a certainty of the presence of 'consciousness' has been sought by the structuralist. I need here refer only to the long drawn out controversies over the question of the awareness of undiscriminated contents of 'consciousness' and to the 'stimulus error' problem. The latter consists essentially in making an 'introspective' report upon something other than a state of 'consciousness.' It thus becomes impossible for the experimenter to determine whether the subject is 'describing consciousness' or whether he is simply talking and giving 'information about it.' (This 'stimulus error,' of course, is not an error found in behavioristic studies. It is an error committed and recognized by the structuralist in his attempts to grapple with 'consciousness.' The problem could be made clearer in detail by a discussion of introspection in its relation to the Type-X situation, but the present paper cannot undertake the work.)

If it is undesirable to attempt the task of limiting psychology to the study of the irreversible *SP–LR* relationship, it is equally undesirable to attempt to ignore that phenomenon. As concrete verifiable processes of human nature possessing adaptive value of a characteristic order, these relationships demand investigation of the most thoroughgoing kind. Psychology [1] will therefore include both types of subject-matter.

[1] It has been said that 'behaviorism' could never have appeared if the method of 'introspection' had not first discovered the fundamental problems of human nature. The implication is, since historically the two points of view, or methods, are so related, that, therefore, the 'introspective' method is the more fundamental and should continue to be treated so. Many methods, however, have been used in science which have later been shown either to be premature or inadequate, or both. It is quite possible that the Type-X situation is so complex that its final scientific envisagement will be best secured through the indirect approach which our paper has suggested. Certainly

And, if I read the signs of the times aright, the work on the irreversible *SP–LR* relationship will become less and less dominant in the science until a thoroughgoing attack can be made upon it in the light of methods and results derived from work upon simpler but otherwise comparable phenomena.

it is reasonable to suppose that, in a hierarchy of stimulus-response relationships, scientific progress will be most dependable if investigation is from the simple to the complex and from the more to the less readily controlled.

BEHAVIORISM AND BEHAVIOR, I

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FUNDAMENTAL PRINCIPLES
- Introduction
- Behaviorism and Metaphysics
- Behaviorism and Physics
- The Ultimate Elements
- The Movement Continuum
- Biophysical versus Biosocial Equivalence
- Coöperation in Human Behavior
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THE HUMAN RESPONSE
- Classification of Responses
  - The Biophysical Responses
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- The Genesis of the Implicit Response
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- The Recording Response
- The Discriminative Response
- The Test for Discrimination
- The Serial Response
- The Relational Response
- Generalization and Abstraction
- The Self
  - Language Behavior
  - The Aims of Behaviorism

Introduction.—With the development of the behavioristic conception in psychology it is necessary to reach an agreement on one meaning of the term *behavior* and its derivatives. We may not all agree on the definition, but unless a beginning is made to designate what facts and relations between facts, and upon what theoretical assumptions the behavioristic conception is to rest, its status will soon assume the same ambiguity which now characterizes the

terms mind, mental, consciousness, etc. The writer heartily supports Professor Warren (9) who maintains that many of the controversial points in psychology would be given a different turn if more care were taken to designate the fundamental assumptions or facts upon which arguments are based. The absence of a modern dictionary of psychological terms,[1] makes the variability greater than it would otherwise be, but as soon as psychologists will be content to accept a modest place at the *end* of the science series instead of trying to lead, the clearness and rigor of all science will soon be theirs. In this article the writer presents what he considers the fundamental principles underlying human behavior [2] and discusses in connection with these principles some of the recent papers directed against behaviorism.

At the outset and before beginning the analysis of human behavior I wish to state my attitude on consciousness.[3] Many

[1] In this paper I shall, whenever I can, make use of the definitions and delimitations of psychological terms prepared by a committee of the American Psychological Association (15, 16) and published in the PSYCHOLOGICAL BULLETIN. While the number of terms defined is small, the report represents whatever uniformity does exist. For my own part I should like to see the list extended and revised periodically, say every five or ten years, along the lines started by this committee.

[2] The Terminology committee (15) definition 27a, of behavior as 'the reaction of an *organism* to its *environment* (biological usage)' comes nearest my own conception of behavior, although I would exclude from the definition those reactions which do not have a social significance. A more detailed analysis will be given in Part II of this article, under the heading 'The Human Response.'

[3] The Terminology committee (15) definitions which seem clearest to me define consciousness: 9a, as 'The distinctive basal characteristic of *mental life* in actual process; *awareness*.' 9b, as 'The subjective accompaniment of neural processes.' Mental, 5b, is defined as, 'Pertaining to mind or its *phenomena*,' and in the first 'comment' under the definition of Mind 4, we find, 'These mental phenomena may be treated either alone or in connection with the bodily organization on the basis of which they are integrated.' The report does not include a list of the criteria which make it possible to differentiate between the mental and the physical. In the absence of such a list (for which, of course, the committee is in no way responsible) I assume that, if the properties of the mental processes are not reducible to physical processes whether known or unknown, then there are at least two separate entities making up the universe. If, however, the mental or conscious processes are regarded as particular types of chemical or physical processes of as yet unknown composition then only one entity or one system of events need be assumed and consciousness or mind belongs to the system of physical monism although it would be scientifically simpler not to use such terms as consciousness, or mental at all, but merely indicate the events to which they refer by those physical properties which most adequately describe them, as is done in the other sciences.

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writers take it for granted that when they use this term every one else uses it in the same sense in which they use it. Thus in an able discussion of the influence of biology on psychology, Professor Davies (**2**) states: "I do not see that behaviorism, so long as it remains on scientific grounds, can be criticized for starting with the reality and observability of behavior; but if and when it discusses the mental order, either as something that does or does not exist, it is open to the criticism of raising a question which, because the answer to it must ultimately rest upon an appeal to consciousness, undermines its own position" (p. 175). Of course, this statement is meaningless to those who deny the existence of consciousness in any traditional sense in which the term is used. A general definition of the type—consciousness is *that something which* specifically may be characterized as redness, sweetness, affection, awareness, envy, etc.—has proved inadequate. The 'that something which' type of definition is tautological. For one who would define human behavior as a form of motion, for instance, an 'appeal to consciousness' is merely an expression of futility; one might just as well appeal to intuition. If we pass to the extreme represented by Professor Wheeler (**13**) consciousness seems to be regarded as a physicochemical (or physiological) process. "All we know," he says, "about the problem (consciousness) is the fact that as yet science has not discovered an adequate method of investigation whereby ideas can be studied directly, after the fashion of studying chemical processes in a test-tube. . . . Hence there is no positive evidence that mental processes are 'subjective' as contrasted with 'objective'" (p. 110). Certainly Davies and Wheeler are not referring to the same phenomenon. Suppose Wheeler to be successful in his reduction of what he calls consciousness to an objective condition. What justification is there for calling anything by the name of consciousness which can be completely reduced to physics and physiology? The fact that an analysis is now impossible does not justify Wheeler's subjective terminology. There are many physical problems which elude the physicist's skill but he does not call these *unknowns*, consciousness, nor does he regard them as

psychological problems. An 'idea' that is a physiological process, is not an idea in any historical meaning of the term. Then why support an elaborate system of terminology in order to describe chemical or physiological 'unknowns'? If consciousness is objective, then a physicochemical analysis (not introspection) is the most effective analysis. This, however, is just what behaviorism means.

With the exception of modifications which will be considered in more detail under other headings, I stand with Lashley (4) as expressed by his statement, "Grant me the postulates of the physical sciences, and I can show you how the phenomena of mind may arise within a system which has no other attributes than those which the physicist ascribes to his phenomenological world" (p. 246). This places behaviorism in with the physical sciences and commits me to the systematic position that, theoretically, human behavior and human achievement are forms of motion.

Fundamental Principles

Behaviorism and Metaphysics.—I do not agree with Rosenow (8) when he protests 'against the introduction of *any* theory of reality into psychology' (p. 193). As long as psychologists refuse to take a stand on some theory of reality any attempt to reach an agreement as to the causes of human behavior must be futile. The present lack of agreement is largely due to the very fact that as soon as a discussion approaches the fundamental assumptions upon which the controversy rests, the real issue is avoided by a hopeless,—'but this is approaching the field of metaphysics with which psychology has no concern.' After all, there is very little real controversy as to what is observed; the difficulties arise when the observations are to be analyzed or classified. To refuse to classify them on some fundamental basis, and this is what Rosenow's attitude means, simply blocks scientific development.

It seems to me that philosophy has about exhausted the disciplinary value of the *metaphysical conception* as a device for restraining scientific speculation and development. Cer-

tainly the behaviorist can no longer remain intimidated. Metaphysics for the behaviorist is merely a form of behavior which familiarly is known as 'guessing' and which technically consists in developing a verbal description of what would be observed if more refined experimentation or observation were possible. One of the problems of science is that of determining the antecedent conditions which precede the appearance of some experimental or technical result. Next the antecedents of the antecedents are investigated, and so the investigations are continued backward until a stage is reached beyond which scientific investigations have not gone. As a metaphysician the scientist tries to anticipate what those antecedents are which have not yet been experimentally established. This is guessing, and the scientific usefulness of the guess will depend upon how well it is verified when the experimental technique will have been refined to the point at which a testing of the validity of the guess or prediction is possible. Thus until recently, by following this method, the chemist regarded the atom, of which he postulated about ninety different kinds, as the ultimate unit in the structure of matter. As experimentation became more refined, the guess of ninety different kinds of units was not verified. A new guess was proposed by the physicists,—the electron-proton conception, in which the number of units was reduced to two. For the physicist then, the electron-proton conception is a guess as to what would be observed visually if he had a microscope of sufficient magnifying power. On the whole the physicists who *use* the microscope, *perform* the laboratory analysis, and then *report* the results, should be better qualified to give reliable guesses than the professional metaphysicians whose guesses can only be derived from the *verbal* reports of the physicists.

Of course electrons and protons are metaphysical constructions which belong to the same category as, 'the thing-in-itself,' 'neutral stuff,' 'élan vital,' 'psychical force,' but when we are faced with the problem of adopting a fundamental assumption toward which the analysis of human behavior might regress, the physicist's electron-proton *ultimate reality* has the advantage that it can be synthesized into complex

phenomena; atoms, molecules, protoplasm, animals, man, social organization. On the other hand the *ultimate realities* of the professional metaphysicians seem incapable of synthesis into anything more practical than the property of *uniqueness*. I adopted the electron-proton type of metaphysics as, in my opinion, best adapted to the study of human behavior.

Behaviorism and Physics.—For the physicist, his own behavior and that of others does not constitute a problem in physics. He does not for instance try to reduce his own habits to a parallelogram of forces. One of the important relationships in physics is that which exists between mass and acceleration. In fact so useful has this relationship become that the product of mass and acceleration has been given a special name, that of 'force' and the technique of using the equation is described in most text-books on physics. Suppose the physicist were to ask himself, How did this equation get into the text-books? This would be a typical problem for the behaviorist,—not an easy one to be sure. The physicist would not expect the equations in the texts to have the same relative importance when he investigates his own behavior, even though he may (as the behaviorist does) regard his own behavior as a physical phenomenon. Therefore, even though the behaviorist classifies himself as a physicist, he must develop, so to speak, special equations (individual and social measurements) which meet his special requirements. Regarding the universe (which of course includes man and his work) as a physical continuum composed of nothing but electron-proton aggregates and the movements that take place among them, the physical sciences investigate these aggregates and classify them into the categories of mass, length, time, acceleration, electric, magnetic, and mechanical energy, and the many other relationships, characteristic of physics, chemistry, and physiology.

The principles according to which these classifications are developed are directly or indirectly based upon the principle of the conservation of energy (or motion). But the properties of the electron-proton aggregates may be classified in other ways, even into categories in which the conservation of energy

is relatively unimportant. Human behavior is such a group of categories. This does not imply that human behavior is not physical or that it does not conform to the law of the conservation of energy. It does mean, however, that we must recognize that individual and social measurements are physical (not mental) measurements and that the equations stated in centimetergram-second equivalences by which we now express the causal relationships between electron-proton aggregates, must be expanded so as to include such *behavior* equivalences as, spelling activity, obedience, going to church, war, or generally speaking, the individual-social activities which establish the individual's status in the social organization. I believe that spelling activity can be reduced to a parallelogram of forces but the forces will be cultural status, health, competition, heredity, both social and individual.

The Ultimate Elements.—When human behavior is held to be a form of motion, psychology assumes the systematic status of physical monism, the ultimate elements of which are electrons and protons. The properties of these ultimate elements are those which have been assigned to them by the workers in physical chemistry and may be resolved into mass and motion as described by H. B. Lemon (**5**). Upon the assumption of the validity of the law of the conservation of energy (motion) every electron-proton change that occurs, redistributes or modifies the stresses or strains that are present in every other electron-proton aggregate, including of course the particular aggregate known as the physicist or behaviorist.

Beginning with the fundamental assumption of physical monism in which the ultimate and sole elements are electrons and protons, we may establish the following series based upon complexity in organization: Electrons and protons form atoms ranging in complexity from the neutral hydrogen atom made up of one electron and one proton, through over two hundred distinct atomic configurations (including the isotopes) to the complex electron-proton structure of radium. Atoms form molecular organizations again ranging in complexity from the neutral hydrogen molecule made up of two electrons and two protons, through an unlimited number of

compounds ending up with such complex structures as the albumins, forming a relatively stable organization made up of thousands of atoms. Molecules form systems of chemical compounds the most complex of which are the protoplasms. Protoplasmic complexes form groupings beginning with the filter-passing bacteria and ending with the complex cell structure of the protozoa. From the differentiation and grouping of cells are derived organs, tissues, and structures which form the metazoic or multicellular systems that found their largest representatives in the prehistoric herbivora. In man the metazoic type of organization is being augmented by what we may characterize as a *compound multicellular* form of organization, the group, tribe, state, nation, representing the highest degree of complexity in electron-proton organization so far as we know.

The human response is a unified group of contractile effects through which the compound-multicellular organization called social organization becomes, shall we say, more complex, more stable, and larger? We do not know. It is part of the behaviorist's problem to find out.

In adopting physical monism any conscious or psychical entity as distinct from the physical electron-proton entity is, of course, excluded. The formulation of the behavioristic position is then expressed in the statement that all human conduct and achievement reduces to *nothing but:* (*a*) different kinds of electron-proton groupings characterized according to geometrical structure; (*b*) the motions that occur when one structural or dynamic form changes into another. In other words, I assume that the scientific study of what is generally known as the educational, vocational, administrative, recreational, and personal activities of individuals, can be conducted with the physicochemical continuum as the sole existential datum and that the totality of the electron-proton aggregates is the universe. Of course, I do not imply that human achievement can now be reduced to an electron-proton formulation. Neither is this possible in physics itself. My statement merely implies that I am opposed to the general attitude that until the last event or occurrence

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(especially those known as human achievement) has been reduced to a mechanical resultant, we must assume the existence of a non-physical (psychical) entity. It seems to me scientifically more expedient to follow the physicists who have inverted the principle and refuse to accept a psychical entity until all mechanical conceptions have proved futile.

The Movement Continuum.—When the behaviorist begins to formulate the facts which he is to include under the term behavior on the assumption that the universe is the totality of the electron-proton aggregates and the changes that occur in their spatial relationships, he may begin his analysis in the following concrete manner: Observing an infant which he must regard as an electron-proton aggregate, he finds that the child's visual and auditory sense organs are being exposed to practically the same electron-proton conditions as his own and the adults around it. Yet its responses are entirely different. If for instance the child's nurse responds to the position of the hands of the clock by preparing the infant's bath, the infant if it responds to the clock at all will do so by cooing, crying, listening posture, etc. Unless the infant responds to the clock in some specific manner, there is no way for a behaviorist to determine whether that electron-proton aggregate known (to the behaviorist) as a clock, is modifying that aggregate known as the infant. Further, both clock and infant are only specific movement effects produced in that aggregate known as the behaviorist. That is, according to the electron-proton hypothesis, clock, infant, writer, reader, time, space, electrons, or protons, are all forms of motion and in the absence of any motion these things would not exist. Of course there is nothing remarkable about this. The term existence is only a synonym for movement, and when we say that without motion the universe would not exist we are only stating the tautology that, 'if there is no motion,—there is no motion.'

The 'individual' on the basis of physical monism, is to be regarded as a locus in this movement continuum; and a function (in the mathematical sense) of the changes that are occurring in all other electron-proton aggregates. A human

movement is a cross-section of this locus at a given time; is the *effect* of antecedent changes; and the *cause* of subsequent changes. Some of the combinations of movements are classified as human behavior and in these the antecedent changes are the stimuli, and the movement combination which is the locus of orientation is the response. This response may precede changes in another segment of the continuum that is taken as a locus and thus be the stimulus for a series of movements in another individual. A response is thus a relative term and may be classified in two ways: (*a*) as the effect of antecedent movements, (*b*) as the cause of subsequent movements. Since, however, the locus of the cosmic movement continuum is in the sensori-motor system of the individual, its properties will depend upon sensori-motor organization, and the properties of the movement continuum can thus only be described as functions of, or in terms of, human responses. The problem of investigating these properties becomes that of selecting as standards of comparison, those responses that are:

1. Relatively independent of the personal variations in sensori-motor organization;
2. Easily acquired and made uniform from individual to individual;
3. Serial in character and readily described mathematically and graphically;
4. Released by the sense organs having the greatest sensory range, either unaided or supplemented by precision instruments.

From responses selected on this basis are developed the fundamental physical categories of space, mass, and time; the c.g.s., (centimeter-gram-second) system of measurements: the fundamental physical categories of light, sound, pressure, motion, vapors, solids, liquids, gases; and the physical, chemical, and electromagnetic properties. For the physical sciences the stimulus represents electron-proton conditions that are independent of the sensori-motor organization of the individual nor is the effect of these stimuli on the responses of individuals given theoretical consideration.

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For the behaviorist, however, the sensori-motor component in the development of the physical categories cannot be taken as zero, but only approaches a *constant* (in the mathematical sense) as a limit. When the social categories are considered the sensori-motor component becomes a variable having very wide limits. This is the condition when the response of one individual becomes the stimulus for another.

When a response is classified on the basis of the physical c.g.s. system of units (as a series of muscle twitches) the responses of other individuals who are able to make such an analysis will be relatively uniform. When, however, a response is classified on the basis of the personal or social effects it produces in others, these effects will depend on:

1. Variations in the sensori-motor conditions as determined by inheritance and past functions;
2. Social conditions and special training;
3. Age and social status;
4. Historical and cultural antecedents of the group, race, nation, etc.

From responses selected on this basis, are developed the fundamental social categories such as coöperation, political organization, morality, the influence of history, democracy, religion, etc.

For the behaviorist the stimulus is not restricted to the hypothetical non-sensori-motor conditions which precede a response, but the response itself is regarded as a stimulus which modifies the behavior of other individuals, or of the individual himself.

Depending on the degree of sensori-motor participation, two distinct types of investigation have developed: (*a*) the physical sciences which establish the properties of the movement continuum as independent of the sensori-motor organization of the individual; (*b*) the social sciences which establish the properties of the movement continuum as dependent on sensori-motor organization.

Behavioristic psychology occupies an intermediate position, on the one hand investigating the effect of physical conditions on sensori-motor functions, and on the other the effects

of sensori-motor function on social organization. Its specific contribution to general science I regard as that of bridging the gap between the physical and the social sciences and explaining social organization and individual achievement in terms of physical and mathematical methodology. Thus there arise two criteria with respect to which human movements may be classified: (*a*) as neuromuscular effects of *preceding* movements, (*b*) as neuromuscular causes of *subsequent* movements. I have differentiated these classifications by the terms biophysical and biosocial. I shall use the term biophysical for the neuromuscular or muscle-twitch phase of the human response, and the term biosocial when a response is classified with respect to its stimulus character either for other individuals or for the same individual at a later time.

Biophysical versus Biosocial Equivalence.—As neuromuscular effects two responses differ from each other to the extent that the physiological conditions of sensitivity, conductivity, and contractibility differ in corresponding receptors, neurons, and effectors. This anatomico-physiological equivalence I shall designate as biophysical equivalence. When, however, the movements in human behavior are grouped and classified not on an anatomico-physiological basis, but as to their effects as *stimuli for other individuals* a complete change in the movement groupings occurs. This I have designated as biosocial [1] equivalence. To illustrate: Suppose I receive an invitation to a dinner from a friend in another city. I may accept this

[1] In an earlier article (**12**), I use the compound word 'individual-social' (instead of biosocial) to describe this phase of the response. I also suggested the use of the special term *signal* for the biosocial phase instead of the term stimulus, which was to be used only when the muscle-twitch phase of behavior was considered. Warren (**10**) suggests the term *sign* instead of the term signal, and objects to the degree of emphasis which I place upon social situations. I trust that the greater details of this article and the modifications which I have made will meet Warren's objections. I have dropped the term signal or sign, because I believe the terms biophysical and biosocial make the distinction between stimulus and signal superfluous. I had considered using the term *reaction* for the biophysical or muscle-twitch phase, reserving the term *response* for the biosocial phase. But the real difficulty, it seems to me, is to show the relation between biophysical and biosocial, and if, as I believe, the distinction is important, it may be better to hold to the adjectives biophysical and biosocial until the distinction is established.

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in at least four (physically) different ways: (*a*) by telephone, (*b*) by telegraph, (*c*) sending a messenger, (*d*) writing a letter. As four neuromuscular combinations, all of these responses are different, but as stimuli for my friend, all four of them are practically equivalent. This *behavior* equivalence is demonstrated by the fact that if my friend had telephoned his wife my ability to accept, his telephone message to her need not have indicated which of the four methods of accepting I had used. In other words, the four methods of accepting are *socially* equivalent because any one of the four (as a stimulus) releases the *same* response. As sensori-motor conditions they are *different.* The four methods only reveal their behavior equivalence when measured by their stimulating effects on others.

If the study of human behavior is to achieve a scientific status and is to be handled as a segment of the cosmic movement continuum, *both* the biophysical and biosocial properties must be studied. I wish to direct especial attention to the fact that biophysical and biosocial do *not* refer to two *aspects* of the same thing, say the type of sensori-motor organization. The classifications which include responses that are biosocially similar need not show any biophysical similarity.

It is not likely that the sensori-cerebro-motor system of man, either as to structure or as to function, has changed very much during the last five thousand years. Some authorities on genetics would say that there may be even a deterioration since the Greeks, on account of a less rigorous selection of those who survive in the struggle for existence. Would any neurological insight, no matter how perfect, of what Professor Warren calls the 'adjustment process' enable us to rebuild past historical events without an external social factor? I think not. If for instance archæologists were to find something equivalent to our modern phonograph and cinema records, taken at the Greek period of Plato, would not this class of records augment the behavior or cultural history of this period to a much greater extent than say the discovery of neurological and physiological charts and descriptions of the sensori-cerebro-motor conditions of the individuals of

this period or even of Plato himself? Or suppose we ask the traditional question, what kind of 'minds' did these people have or what was their status in memory, imagination, and thinking? Would not this question be answered more adequately from the phonograph and cinema records than from the neurological analysis of the sensori-cerebro-motor records? I do not believe that any neurological insight alone will enable us to determine what the *stimulating effects* of a given neuromuscular configuration will be *upon other individuals.* From phonograph and cinema records, books, etc., we do get this type of data and without any reference to sensori-cerebro-motor conditions.

It is of course always possible to maintain that our biophysical methods of analysis are still imperfect, that physiology and neurology are not far enough advanced, but I believe this argument applies to biosocial analysis with still greater effectiveness. The method of biosocial analysis has just begun. When the conception of a mind and consciousness will have been recognized as tautological statements of problems in human behavior, instead of an explanation of behavior, biosocial analysis will proceed rapidly. When we recognize that the phrase,'I responded because I attended,' only means, 'I responded because I responded,' we shall be ready to investigate the biosocial problem of how our responses develop.

I do not wish to be understood as underestimating the value of neurological insight, but the study of human behavior and human achievement demands more than the investigation of the sensori-cerebro-motor conditions, and this more is not a super-physiological factor but merely an investigation of what I have characterized as the compound-multicellular form of electron-proton organization.

Coöperation in Human Behavior.—Early life was non-coöperative. Each plant or animal grew and thrived according to its available food supply—ignoring those forms which did not compete directly, avoiding those forms which destroyed it. In so far as there was a social plan in behavior this was one of *symbiosis* or *parasitism.* Out of this developed the *exploitation,* either of submembers of the same species or of

other species, as is exemplified in the colonies of bees, ants, wasps. In man exploitation has reached a high degree of perfection, involving not only members of the same species but all animate and inanimate resources. Along with this, coöperation developed between members of the same group (family, tribe, nation), at first directed toward the exploitation of adjacent organizations and individuals, but gradually extending its range to include larger and larger social units. Social organization has become a device through which the sensori-motor equipment of one individual is placed at the disposal of other individuals in the organization, and it is this interchangeability of receptor-effector functions between individuals, that I have designated as coöperation. In man coöperation has made the human response both an individual and a social event.

I have tried to show that the actual neuromuscular factors that were involved in human behavior are relatively unimportant as compared with the *stimulus character of the response for other individuals*. This is the characteristically human element in human behavior, and gives us libraries, telephones, telegraphs, historical records, which in themselves are the sensori-motor effects of individuals now gone. When human responses are investigated on the basis of their effects as stimuli on other individuals in addition to their neuromuscular characteristics, such conceptions as consciousness, mind, mental, psychical, will simply vanish. Because many neurological principles have not yet been isolated does not imply that the investigation of human behavior must languish until they are. Human behavior and human achievement is merely the product of conditions in which the range and complexity of electron-proton organization is extended beyond that of the multicellular form. The disadvantages of variable, perishable, spatially and temporally limited individual sensori-motor function is being supplemented through the survival of those stimulating conditions (the social environment) by which social evolution is replacing organic or individual evolution.

Monodualism.—In the attempt to avoid the inconsisten-

cies of a thoroughgoing dualism such as is implied in psychophysical parallelism, behaviorism is sometimes assigned the buffer rôle of being one aspect of something that is monistic in its essentials.

Professor Fernberger (3) recognizing the inadequacy of the older dualism tries to achieve monism by reducing the older psychical factor to what seems to me a terminological variant of one phase of the physical factor. "The material of this science" which he calls the science of consciousness, "is merely the conscious middle term in the reaction chain and nothing more. In this we would include a study of the conscious elements, of their integration and of conscious meanings. . . . We advocate, then, the separation of the present psychological discipline into two distinct and independent sciences. Both have their point of view, both have their different interpretative categories, both have their distinct materials for observation, and both have their methods" (p. 411). If there were actually the agreement between psychologists that these statements imply, the problem would be simple. But, first, what is an 'interpretative category' and in what way does it differ from an ordinary category. For me the process of *interpretation* is merely the name for the act of classifying when the things to be classified may be placed in a number of *alternative* categories. I might, for instance, interpret a nervous process in the occiptial lobe as: (*a*) an electrical process, (*b*) as a physicochemical process, (*c*) as some proportion of all the cerebral processes, (*d*) as a particular part of a given reaction mechanism, etc., but when I am asked to *interpret* this nervous process as 'a sensation of redness' it ceases to be a matter of interpretation and becomes one of terminology. From the scientific standpoint this only means that I may at my discretion designate any of the interpretations *a,b,c,d*, that I have given, either as a nervous process or as a sensation. The two distinct and independent sciences of Fernberger are thus only independent because one of them studies a *part* of the 'reaction chain,' and for this part uses a special form of terminology, such as calling some phase of a nervous process a sensation rather than a nervous

process. Secondly, it is very doubtful whether any person who would class himself as a behaviorist would accept Fernberger's definition of a behaviorist as implied in the quotation, "The ideal behaviorist wishes to drop the middle term of the intervening mental process entirely and should be interested solely in the two ends—stimulus and reaction" (p. 410). Speaking only for myself, I fear I deviate rather widely from Fernberger's 'ideal' behaviorist. Furthermore, I doubt if many of the introspectionists follow Fernberger when he affirms that, "the true out-and-out introspectionist should, by the definition of his point of view, be interested solely in the stimulation and mental process parts of the chain. He should properly have no interest whatsoever in reaction" (p. 410). I fear that most of the introspectionists that I have met have not conducted themselves 'properly.' Their interest in human behavior did not seem to be one whit less keen than my own and their interest in the introspective technique was primarily because of the fact that it seemed to them to offer a solution for many of the problems which have confronted mankind from the dawn of history and for which (apparently) there is no purely physical explanation.

At this point Warren's (10) discussion on the definition of the term behavior may be reviewed in relation to the preceding. He says "Behavior, as I define it, is the final term of a three-stage process which psychology investigates. The first stage is *stimulation.* The second stage may be called *adjustment;* it is the operation of the adjustor system. The final stage is the *response* proper. Behavior is the creature's total response to any given system of stimuli—that is, to a given *situation* . . . . In other words, psychology is concerned with a certain type of reaction which we may call the 'sensori-cerebro-motor process; or more concisely the *organic reaction*" (p. 482). It seems to me that if we stop here we restrict psychology to one half its subject matter, namely that part which I have called the biophysical response (and which is already the subject matter of neurology and physiology); and disregard the other half, the biosocial response, which is not the subject matter of any science but which naturally becomes

the problem of traditional psychology when psychical or conscious causal factors are eliminated. It seems to me that the time is past when our text-books will be one half physiology and the other half be devoted to a restatement of the content in a terminology which makes use of principles that cannot be assimilated into the evolutionary or causal categories of the physical sciences. It is simply a question whether psychology is ready to go on to a straight monistic basis and drop its vitalism, dualism, anthropomorphism, as biology has dropped them, or whether it is going to potter along until it is gradually submerged and embalmed by the more progressive biologists.

The Difference between Man and Animal.—It is particularly in man that social organization finds its greatest complexity, although the origins are in the infra-human species. In establishing man's biological relationships to the animals the emphasis upon his anatomical and physiological similarity to them has tended to obscure his enormous difference from them in his behavior, and also to obscure the fact that his behavior is characterized by what I have called coöperation. In the past this coöperation was mainly directed toward exploitation, but this seems to be a temporary development of the parasitic principle, to be replaced gradually by a form of social organization directed toward the elimination of those factors which restrict social evolution. The abrupt step from the most complex animal organization to man's railroads, banks, poison gas, Red Cross, League of Nations, gives such obvious support to those theories in which man is regarded as a special creative act of some super-being or force, that the acceptance of a purely mechanistic or biological explanation of human conduct, will be most difficult for the individuals who have studied him most. Man as an anthropological and ethnic unit has been much studied but this study has been based upon at least an implicit assumption that ethnic principles were in some way super-biological and that an analysis of an ethnic group's culture could only be carried out on the assumption of hypothetical, mental or psychical conditions. From the behaviorist's point of view

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these ethnic processes merely represent those bodily movements that ultimately are significant as stimuli for other individuals and that in respect to neuromuscular complexity need show very little correlation with the ethnic status. The biosocial response, which, if of relatively small importance in animal behavior, is the characteristic human response, not because man is not an animal but because he is the only animal that has evolved the principle of receptor-effector interchangeability between organisms. Most adult human reactions have been acquired and represent an interaction between the inherited sensori-motor conditions and the *social* stimulating conditions, and unless the social stimulating conditions are known, the response cannot be classified. Through the language reactions the individual has become an integral part of a system of conditions which make his environment virtually without limit as to space and time. An animal on the other hand can only react to the actual environmental conditions during the period in which it is alive and only within the spatial range of its own sense organs.

Continued in the March issue

THE STRUCTURE OF THOUGHT

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Introduction

Thinking or reasoning is one of the most universal and ethically and psychologically one of the most important types of activity which human beings, to a greater or less extent, engage in. But for so important an aspect of human activity the analysis of the thinking process is in a notoriously bad way. The reasons for this are to be attributed, in part, to the inherent difficulties of the subject, and partly to the historical development of the problem. Logicians have tended to leave to the psychologist the problem of the function of thinking in the biological processes of adaptation. For the intellectualist and the majority of formal logicians the mind is conceived of as a rational principle of analysis and synthesis. This view, which regards mind as a non-biological factor, is embodied in most text books of logic at the present time. Thinking is held to be the act of an agent which has for its content certain elements referred to by the terms *concepts*, *images*, *ideas*, etc.

Psychologists, until recently, respecting the alleged sanctity of the intellectual principle of the formal logicians, have tended to regard thinking as not amenable to the usual quantitative methods of study applicable to ordinary biological processes. True, some work has been done on the animal mind and intelligence; the relation of intelligence to instinct has been sufficiently theorized about; and experimental studies of the development of concepts and reasoning processes have been carried out; but the human mind which studies the animal mind hardly dared lower itself to the level of the brute mind from the height from which it surveyed nature.

This dualism was made less absolute by the application of the theory of evolution to 'mental processes.' With the

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progressing insight into the biological mechanisms of organic activity mechanistic psychology has become increasingly bolder. This naturalistic tendency, seeking to establish continuity between the highest forms of human activities and the behavior of the lower organisms, has received impetus from the contemporary Pragmatic, Behavioristic, and Freudian movements. Pragmatism, in holding that intelligence is a biological instrument of adaptation; Freudianism, in reducing reason to the apologetic rôle of rationalizing and sublimating biological cravings; and Behaviorism, in insisting that thinking is an implicit form of muscular response; all tend to cut under the intellectualistic theory of thinking. There is no metaphysical entity, mind, which is a unique influx into the continuous stream of evolution. Intelligence is a property of the increasing complexity of neural tissue. It is biological in character and origin.

The effect of these movements has been to bring the two fields of logic and psychology into closer relations and to sharpen the conflict between formal logicians of the older school and those who uphold the biologizing tendency.

On the whole Behaviorists and Pragmatists, whatever their differences may be, argue in common that intellectualistic logic has tended to ignore the organic value of thinking in the individual's adjustment to its environment. On the other hand, Intellectualists contend that the Behaviorist over-simplifies the problem. He overestimates biology and underestimates those very logical processes and mathematical manipulations which enable him to arrive at a biological theory.

The purpose of the present essay is to delineate the main aspects of a movement of thought, and to state the various interpretations of the act and the content of reasoning as viewed by different types of psychology. The analysis of thinking breaks up into the problems of (1) the logical structure of thought; (2) the psychological structure of thought; (3) the physiological structure of thought.

We will discuss these aspects of the problem in their respective order.

The Logical Structure of Thought

Traditional definitions of logic usually state that it is the science of correct thinking. In the past logicians have tended to assume that all the principles by means of which thought arrives at valid conclusions have already been formulated. But it is now generally recognized that many of the logical principles governing inference are still in the process of formulation. Therefore, any definition of logic which suggest that it is static and complete is premature. Furthermore, that modern logic has gone beyond its original scope is evinced by the recent inclusion of mathematical logic within the confines of necessary inference. Bertrand Russell's (1) rather extravagant statement, "The fact that all Mathematics is Symbolic Logic is one of the greatest discoveries of the age," loses some of its force in the light of Poincaré's (2) later criticisms. But however this may be, logic now contains within its boundaries mathematical logic and scientific method, and, in view of its broader content, may best be defined as synonymous with methodology. Logic or methodology, then, is concerned with all the fundamental modes of procedure by means of which the field of knowledge is enlarged.[1]

The judgment is the typical form of the structure of thought. The process of reflection, implicitly expressed in a judgment and explicitly stated as a proposition, is a process of relating terms. All thinking can be reduced to the form of terms and relations, which are logically and psychologically so simple that they have been held to be indefinable. What is termed the *propositional function* is not in the term-relation form, as it stands. The propositional function, represented symbolically in the form $\phi(x)$, is analogous to the mathematical concept of functional relationship (3). In the proposition the subject term and the predicate term are usually class names, and in symbolic logic a class consists of the terms or values that satisfy the propositional function. The propositional function with one variable is called a concept. (4)

[1] I am indebted to Dr. A. E. Avey for aid in my exposition of symbolic logic.

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Distribution refers to the extension or inclusiveness of the term.

A term is anything to which attention can be directed or which can be isolated from its environment. Every term is an entity (*subsistent* or *existent*) which has some relation to something else. The very assertion, 'this has no relation to that,' is itself, logically, a relation. A relation, then, is that which holds between terms.

There are many types of relation, just as there are various kinds of terms. Frequently the predicate term states some quality or attribute of the subject term. The possibility of any assertion rests upon the principle of identity, $T \equiv T$, which is a special case of the wider principle that a term is related to itself, $T_1 R_1 T_1$.

The simplest form of thinking is represented by a statement of the first type: $T_1 R T_2$; concretely, 'all men are vertebrates.' But thinking is usually more complex than this. An assertion of the second type, $(T_1 R T_2)\ R_2 T_3$, is an assertion about an assertion in terms of another term; a concrete example being, 'all men are vertebrates' is true. An assertion of the third type $[(T_1 R T_2)\ R_2\ (T_3\ R_3(T_4))]$ is illustrated concretely by, 'all men are vertebrates' implies 'no invertebrates are men.' Logically there are an infinite number of types, though psychologically thought is limited by the span of attention and the range of relations that can be dealt with.

There are certain general properties underlying all relations. Before stating these we must observe that every relation has its converse: $R <$ (implies) $\breve{R}$, though the converse must preserve the original distribution of the terms. The types of relation are:

Symmetrical relations: $(R_1 < R_2)\ (R_2 < R_1)$
Asymmetrical relations: $(R < R_1) \not< (R_1 < R)$
Transitive relations: $(xR_1y)\ (yR_1z) < (xR_1z)$
Intransitive relations: $(xR_1Y)\ (yR_1z)\ (xR_1 * R_1z)$

Relations of equality are symmetrical. Relations of inequality, 'A is less than B' are asymmetrical. The relation 'is north of' is a transitive relation. The syllogism of impli-

cation is the best known case of the transitive relation. Relations of quantity, space relations, causal relations and temporal relations are transitive. Equality is transitive as well as symmetrical (**5**). An intransitive relation is given in the relation 'is father of.'

The laws of intransitive, asymmetrical relations are the ultimate laws of thought, transitive and symmetrical relations being reducible to the former.

The attempt to get at the fundamental ultimate units or elements of thought may be called 'logical atomism,' adopting the phrase coined by Bertrand Russell. The logical atomist is interested in finding the fewest possible primitive principles, relations or axioms necessary to build up all possible forms of thinking. Couturat, in his 'Algebra of Logic,' enumerates fifteen axioms from which all forms of thought can be built up. C. I. Lewis in ('Survey of Symbolic Logic') and A. N. Whitehead and Bertrand Russell, in their 'Principia Mathematica,' have also worked out sets of fundamental principles of symbolic logic. On the whole these systems have in common the notions of simple terms, logical products and logical sums, relative product, the idea of negation and implication. The laws of simplification, commutation, composition, association, and distribution govern the operations of logical entities (**6**). Boole's law and DeMorgan's formula are generalizations covering the logical activities of complex terms.

This completes our summary of the logical structure of thought. The value of the analysis of thought as a logical complex into its elements is that it exhibits the formal processes by means of which we, psychologically, make the inferences which consist in relating new experiences to old knowledge. These are the very processes which we all use in thinking. Any account of thinking, whether by a Behaviorist or Intellectualist, which ignores these processes or fails to explain them stands condemned at the outset, for it is through the use of these logical operations that any system of psychology can hope to establish itself. Behaviorism, for example, if it is to demonstrate itself as the 'true' psy-

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chology must show how the logical categories are deducible from its own categories of *stimulus*, *response*, *conditioned reflex*, etc. To this problem of the psychophysiology of thinking the remainder of the discussion is devoted. It is obvious that these aspects into which we have divided the process of reasoning overlap at various points.

The Psychological Structure of Thought

The conceptual process is possible because, by an act of attention, we are able to abstract from the totality of experience single items and consider them independently of their total setting. As James (**7**) says, "Out of the aboriginal sensible muchness of experience (the 'big blooming buzzing confusion') attention carves out objects which conception then names and identifies . . . ." People understand each other because they have a common background of 'sensible muchness,' and because we have minds or nervous systems of the same order. Intercommunication of ideas is thus possible. When I say 'this room is hot' you understand me because the terms room and hot 'mean' the same to both of us. If you reply 'yes, it is,' we say that you also believe the truth of this statement.

We communicate our ideas by means of language, which signifies that words or terms are now substituted for the original experiences. We can now react to words, whether the original feature of the environment to which the concept-word applies be present or not. The question as to whether or not an image of the original experience must be present is not so easily decided. If I say, 'the pyramids of Egypt have triangular sides,' you probably have an image of a pyramid. But just how far our thinking can go on without images has been much debated. This is the question of sensory versus non-sensory recall. The problem is not a new one, Berkeley (**8**) arguing that Locke was wrong when he held that he could form an idea of a triangle without deciding what sort of a triangle it was to be. (**9**) In more recent times the problem has been subject to experimental procedure. Thus, Binet (**10**) argues that images form only a small part of the total

phenomenon of thought. The sensory element is exaggerated because of the ease of describing images. Sometimes, Binet states, the series of images is not even consistent with the thought.

The difference between sensory thinking and imageless thought may be translated into the language of conceptual processes by means of the distinction between *empirical concepts* and *logical* or *scientific concepts*. Empirical concepts are close to the particulars of experience, while logical concepts are abstract and marked by an increasing loss of particularity.

We may select as the characteristic psychological categories involved in describing an act of thought or a movement or reasoning the following: *attention*, *percepts*, *concepts*, *meaning*, *abstraction*, *generalization*, *inference*, and *belief*. It is not our purpose to examine all the various interpretations of these conventionalized explanatory concepts, but only roughly to outline the various ways in which thinking as a whole is dealt with by the prevailing 'schools' of psychology. Thus the structural psychology of the Titchenerian sort contends that mental life is composed of certain elements of consciousness endowed with characteristic attributes. According to Titchener (11) there are three elementary mental processes; namely, *sensations*, *images*, and *feelings*. These combined in various ways constitute the more complex mental states. On the other hand, as we shall see in a moment, functional psychologists are likely to argue that these psychical atoms are abstractions, and an analysis of thinking into these artefacts falsifies its functional continuity.

The usual statement, by those who accept 'psychological atomism,' of the development of the 'higher mental processes' runs something as follows: The simplest form of conscious experience is a sensation, a pure sensation being the ideal element uncontaminated with memory images from past experience. A simple perception is the grouping, by an act of attention, of these sensations, thereby unified into an object so that it takes on meaning. A perception, then, is made up of what is immediately given, plus supplementary memory

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images fused with the sensations in such a manner that we recognize the object. An idea is an association of images, while a concept is an abstract idea or a composite image. The image is usually regarded as a centrally aroused sensation, a remembered percept called up according to the laws of association.

There has been much criticism of the structural psychology which describes mental states in terms of mental atoms. The belief is current that these elements which are supposed to combine to form the mosaic of mental life are abstractions. Structuralism, with its make-shift of psychophysical parallelism, is strong on its descriptive side, but weak on the explanatory side. Functional psychologists and pragmatists are interested in that side of psychology which exhibits the rôle of the thought processes in organic adjustment to environmental demands. Ideas are dynamogenic in that they have motor consequences. Carried to its full consequences functional psychology must become either interactionism or behaviorism.

McDougall (**12**) also has criticized the view which we have called psychological atomism. Including associationism and sensationistic psychology in his polemic, he repudiates all attempts to display consciousness as a flowing mosaic of entities. Experience is not to be described in static terms, such as 'sensations,' 'ideas,' 'percepts,' and 'concepts,' but only in dynamic terms. McDougall's discussion of the notion of 'meaning' is interesting. He explains (p. 253) the divergence of opinion concerning the problem of meaning by arguing that 'meaning' can not itself be made the object of introspective observation, as sensory qualities and other modes of experience can. This follows from his view of perception, which is worth noting.

He objects to the usual distinction between perception and conception, as though they were different functions, with conception as the loftier kind of mental activity. Perceiving, he holds, is one kind of conceiving. Perception is a process of 'meaning' objects (**13**). Perception, in his 'psychic stimulus theory,' is essentially a synthetic activity, a view

which Dr. Head's neurological studies confirms; it is the fundamental function of mind, not to be explained by any simpler process. Thinking of an object is a unitary act, a psychic response to a multiplicity of stimuli. McDougall therefore objects to any identification of meaning with sensations and images, either at the focus of consciousness or in James's 'fringe of thought.' McDougall's view stands in contrast with R. H. Wheeler's (**14**) doctrine of meaning as the mass of vague marginal sensations and images, largely motor and kinæsthetic.

Dr. McDougall, apparently, chooses to identify himself with the movement known as *self-psychology*, sponsored in this country by Miss Mary W. Calkins. Dr. Calkins (**15**) has repeatedly defended the thesis that the feeling of activity is present (if sometimes unobserved) in all introspection. This consciousness of self is an essential component of the act and should not be ignored in psychological explanation. Dr. Wheeler, (**16**) on the contrary contends that the belief in self-activity claimed to be found in volitional activity rests upon a failure to analyze the 'mental activity' and 'volitional consciousness' into their ultimate data, consisting largely of refined motor adjustments.

It is clear that we are now approaching the problem of the physiological conditions of mental processes. But before considering the neuromuscular conditions of thinking we must at least indicate the interrelations of logic and psychology as developed in the German literature of the subject. Continental thinkers have probably contributed more to this subject than the English and Americans, though in England Bradley, Bosanquet, Stout, Russell, and others have devoted much time to these problems.

Among the outstanding figures in the Continental movement must be noted Brentano, Meinong, and Husserl. This general tendency, with which the names of O. Külpe, Th. Lipps and Stumpf are also linked, Titchener (**17**) has called 'The Psychology of Act.'

Franz Brentano's view, set forth in his *Psychology vom empirischen Standpunkte* (1874), has had a potent influence

on later thinkers. His view that reference to an object is the peculiar characteristic of mental phenomena has been developoped by Brentano's successor, A. von Meinong, in his *Gegenstandstheorie* or *Theory of Objects*. According to Meinong's (**18**) doctrine there are three elements in the thought of an object, namely: the *act*, the *content*, and the *object*. Professor Edmund Husserl, in his *Logische Untersuchungen*, also distinguishes between the act, the meaning-content, and the object of thought. The 'object' may be subsistent or existent, present or remembered.

Without trying to develop in detail the theory of belief, truth and error, consistent with the preceding general view, we may use the foregoing as the background for a few sketchy statements about belief. Belief refers to the attitude taken by the subject in reference to the content of the believed proposition. One can apprehend the meaning-content of a judgment (or what Meinong calls a 'supposal') without believing it or without affirming its truth. This difference is brought out by Brentano (**19**). This is an important distinction.[1] The truth or falsity of a belief depends upon the nature of the relation of the content of the belief to what Meinong calls its 'objective.'

While we cannot here give an extended idea of the character of this general movement it is evident that the 'psychology of act' is similar to the 'self-psychology,' which we considered previously. Russell (**20**) holds that Meinong's 'act' is the ghost of the subject or what was once the full-blooded soul. It may also be pointed out that McDougall's statement that perception means the object is analogous to Husserl's view that the act means or intends the object.[2]

[1] Epistemologists who insist upon the pragmatic character of perception and the motor aspect of ideas have tended to slur over the relative independence of the 'central' aspect from the peripheral aspects.

[2] Positivistic and biologically minded psychologists have tended to sniff at metaphysics. Epistemologists, therefore, are always elated in finding a scientist impregnated with metaphysics. Thus Weyl, in his 'Space-Time-Matter,' acknowledges (p. 319) that his epistemological developments follow Husserl's 'Phänomenologie' and (p. 4) Brentano's theory of intentional objects. At the present time there is a tendency to make the theory of relativity serve as a basis for the reintroduction of anthropomorphism into science. Thus, McDougall, in his latest book, quotes with approval a state-

Little has been said concerning the relation of thinking to the affective processes. The separation of intellect, feeling, and volition into distinct activities of the mind is a heritage from faculty psychology which has well been dispensed with. But the terms are not meaningless, and, if nothing more, may be taken to designate distinct types of behavior or specific modes of functioning. What the relation between the three may be is a question which to answer would take us beyond the scope of the present inquiry. (**21**)

This, then, concludes our survey of the psychology of reasoning, and we are now prepared to discuss the equally controversial questions of the physiological structure of thought.

The Physiological Structure of Thought

Since the greater part of the present consideration of the physiological aspects of thinking is to be a critique of the behavioristic account of thought we can only glance at the general views offered as to the bodily basis of the 'higher thought processes.'

Thinking as a process of associating ideas lends itself readily to physiological explanation. This, at any rate, has been the contention of the association school of psychology.[1] We are not concerned with an exposition of association psychology, as such, but with setting forth modern ideas of the physiology of thought, which have expanded the older system of associationism. One of the properties of neural tissue is that of being modified by experience, *i.e.* the transmission, by nerve fibres, of nervous excitations (waves of ionization or chemical decomposition) leave them in a modified condition. This alteration of the resistence ('permeability') of neural tissue is retained, so that the same stimulus at some future time, in the case of a simple reaction, calls forth the

ment from Eddington's 'Space, Time and Gravitation' which is subjectivistic, Kantian epistemology. L. T. Trowland finds in the theory of relativity a justification for Psychical Monism: Psychol. Rev., 1922, **29**, 201–212.

[1] There is, of course, the problem of explaining the difference between 'free' association of ideas (day dreaming, autistic thinking, or compensation thinking) and 'controlled' association of ideas or reality thinking. The difference seems to lie mainly in the extent to which a 'train of thought' is 'controlled' by external stimuli.

same response, which is thus more quickly and efficiently elicited than it was the first time. Reactions which are thus preserved may be called *engrams* or *neurograms*. Acquired reactions or conditioned reflexes differ from inherited reactions by the fact that new stimuli are attached to old responses or old stimuli are attached to new responses. This constitutes the process of learning, and intelligence depends upon the ability to learn by experience. Thinking is largely the process of delaying immediate responses (thinking, like consciousness, arises at the points where instinctive and habitual modes of reaction break down, is the older way of putting it), and bringing to bear upon a novel stimulus relevant past experiences preserved as neurological residua. Similarly, images offer no insuperable difficulties to physiological explanation. All images and ideas were once perceptions, and the having of an image is, neurologically, the reëxcitation of the neurones originally involved in the perception, by only a part of the original stimulating condition.

In the preceding account we have emphasized the neural side of thought. Perhaps it is true that thinking is a cerebral process mainly in adults, and that in the original learning of things the locus of concepts and meanings may have to be shifted from the central to the peripheral motor segments of the organism. (However, these phases must not be separated too sharply.) This view appears in more recent treatments of concepts and meaning wherein it is stated that, in the interest of economy, the originally overt responses are short-circuited or abbreviated so that the act becomes implicit (**22**), or as Kantor (**23**) says, concepts are the ordinary perceptual responses so abstracted from the original contact with things through the removal of the stimulating object, that they are aroused to action through a substitute stimulus. Dr. Wheeler's view of meaning is illustrative of the general trend in regard to the problem of meaning. He states (**24**), "In our view kinæsthesis is an essential component of the consciousness of meaning and the mechanism of the development of meaning is motor response."

The problem of attention is not so easily disposed of.

Most discussions of attention, such as Pillsbury's ('Attention,' Ch. XV,) fall back upon the theory of neuron drainage to explain the phenomena of attention. In attending to any stimulus we limit the field of consciousness—and this may be either 'voluntarily' or 'involuntarily' performed—in such a way as to exclude certain possible stimuli and facilitate the sensory discrimination of the stimulus attended to. The behaviorists' view that the only difference between voluntary and involuntary activity lies in the system of muscles involved—striped or unstriped—does not seem to account for the feeling of effort which we meet with in voluntary activity. This, probably, is due more to the overcoming of resistances and the final triumph of one pathway over another, within the central nervous system, rather than to the reflection back into the brain of kinæsthetic sensations from the muscles innervated.

The theory of the drainage of nervous energy is based upon analogies in which a stronger current deflects a weaker current into its own stream. This facilitates or intensifies the system in activity and inhibits the functioning of other systems, and this may account for the motor accompaniments of an attentive state. One might object to the above analogy on the basis that neural flux (if there be such, *sui generis*) is not comparable to hydraulic pressure, but even accepting this as a valid parallel, it must be admitted that there remain some things which are puzzling. What, for example, is the neurological difference between attending to the pitch of a sound, in one case, and the intensity or timbre in another? We may therefore concede with Woodworth (**25**) "that we do not know exactly what the focusing of attention can mean in brain terms." But this is no excuse for dualism, for brain physiology has established the fact that the cerebrum is sufficiently complex to accommodate all the activities that can be referred to it. Freudian psychology is sometimes accused of furthering the mysticism which rests upon the inability to convert introspective data into physiology. The notion of the *psychic censor* is one of the concepts which is as vague as it is important in the scheme of psychoanalysis. But

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a monist might well argue that all that happens when we repress an idea which we reject as unworthy of ourselves is that a stronger stimulus, calling forth the opposite response, obtains the 'field of consciousness' and thereby excludes the first idea. Another possible translation into bodily terms of the notion of suppression is presented by Dr. Rivers in his 'Instinct and the Unconscious.'

Having reviewed these more general matters we are now prepared to consider the behavioristic view of thinking.

Behaviorism is a monism of sensory-neural-muscular and glandular events which regards everything as a movement of some sort. It differs from physiology in that it seeks to trace the origin and development of those reactions of the individual by means of which he establishes his biological and social status. The aim of the behaviorist is to make psychology compatible with the universal terms of science, and he takes the physical sciences with their objective, quantitative methods and laws of prediction as the ideal pattern of all science. Viewing both the organism and its environment as configurations of physical elements (*electrons* and *protons*) the behaviorist finds no need for the hypothesis of consciousness or mental life. He need not deny their existence, but, like the æther of space for the physicist, not being verifiable by experiment, they prove to be unnecessary assumptions. Watson contends that it is possible to write a psychology without using the terms 'consciousness,' 'mind,' 'imagery,' 'introspection,' etc. Psychology, as the science of behavior, can be written in terms of stimulus and response, habit formation and habit integration. Human behavior is continuous with animal behavior. A human being is a complex bundle of reaction tendencies all unified into what we call an individual by the integrative action of the nervous system. Personality consists largely of these potential forms of behavior. A *dynamic personality*, for example, refers to an individual whose normal muscle tonus and metabolic level are above average.

A few words as to the antecedents of behaviorism (**26**). Logically, it is the inevitable consequence of a strictly monistic

interpretation of organic evolution. It has resulted from the extension of the categories of animal psychology to the interpretation of human psychology. The application of Mendel's principles of biological inheritance to what were formerly called 'mental traits,' and the increasing insight into the importance of the rôle of glandular secretions in personality have fortified the behaviorists' position. The advent of the peripheral theory of emotion (usually called the *James-Lange theory*) which states that the content of emotion is determined by the interoceptive stimuli reflected back into the central mechanism by a back stroke, must also be mentioned in connection with the development of a biological interpretation of human conduct.

The three outstanding behaviorists of this country are Max Meyer, John B. Watson, and A. P. Weiss. These pioneers are converting other psychologists to the science at what McDougall must regard as an alarming rate. Meyer's type of behaviorism represents the least radical departure from 'traditional' psychology. In his 'The Fundamental Laws of Human Behavior' (1911), Meyer is concerned with tracing out the neural correlates of such terms as the *image* (p. 233). No one can quarrel with this procedure. His attempt (Lectures 16 and 17) at establishing a neural mechanics of thinking is certainly more successful than Herbart's analogous system. However, to those who hold a view in which 'Meaning' is localized as retention traces in the lobes of the cerebrum Meyer's computations of the *resistence gradients* of nervous energy ('Psychology of the Other One,' 1921, Ch. IV) is a waste of time. Without quibbling about his elaborate architecture of the nervous system, the 'centralist' may well insist that what determines the magnitude of the neural flux in a motor organ of a 'big brained' animal is not the quantum of energy of the external physical stimulus as it reaches the sense organ, but the associations which the stimulus arouses in the cortex.

In order to fit thinking into the behavioristic scheme Watson is led to differentiate between immediate response and delayed response, explicit or overt behavior and implicit

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or non-observable behavior. Thinking is delayed, implicit behavior, largely the incipient movements of the vocal musculature. Speech is just as objective as any other muscular act (27). The difficulty has been that instead of looking upon it as a muscular act we have looked upon it as the revealer of 'thought'—the sacred inner secret of the mind. Watson holds (28) that words have grown up around motor acts and have no functional significance apart from them. The alleged reality of consciousness is due to the fact that the subject can phrase in terms of words the habit twists which have become a part of his biological equipment. "The hypothesis that all so-called 'higher thought' processes go on in terms of faint reinstatements of the original act (including speech) and that these are integrated into systems which respond in serial order (associative mechanisms) is, I believe, a tenable one" (29).

According to Watson the most serious obstacle in the way of a free passage to behaviorism is the 'centrally aroused sensation' or 'image.' He cites (30) various reasons why the way is being paved for the dismissal of the image from psychology. We need not consider these here, but only note the statement of Watson's attitude towards the image as set forth in his reply to Russell's criticism in the latter's 'The Analysis of Mind' (31). Watson's argument runs as follows: The behaviorist believes that what most psychologists call the 'image' has a definite cause as truly as does 'sensation.' He has no trouble in finding a means for providing an actual visual stimulus as part of the complex of stimuli which arouse a total reaction to an object not present to the senses. Dunlap, although not a behaviorist, first pointed the way by claiming that the so-called visual image is only an associated eye muscle strain. "In other words, when you are thinking of a definite object (not present to the senses) which the eye has been trained on, 'imaging' it, the eye muscle adjustment takes place actually (though faintly) as though you were seeing the object. The behaviorist without giving up his premises—to the effect that a sense organ stimulus is always present in any reaction—admits the associated muscular

adjustment of Dunlap and also conditioned reflex eye muscle responses (which may have a different origin from the associated) and if necessary can go still further and say that the associated and conditioned reflex muscular responses in the eye may bring about just enough tension upon the eyeball, and hence upon the retina, to start faint retinal activity. It is well known that phosphenes, rings of light, 'stars,' flashes of light, can be produced by pressure and by electric stimulation of the eye. The behaviorist can go still further and maintain that in a normal person the retina is a sense organ of such delicate chemical and physical structure and balance that optical sensory impulses are always passing towards the brain. He might even argue that centrifugal nerve fibers keep the retina constantly stirred up and supplement in this respect the work done by associated eye muscle responses in causing the arousal of actual retinal impulses."

The type of behaviorism represented by Max Meyer has been given a new turn by his former student Dr. A. P. Weiss. The latter psychologist distinguishes two aspects to the stimulus-response relation, the 'biophysical aspect' and the 'individual-social aspect.' The physiologist studies the former, while a mental test, which is a social test, measures the individual's social accomplishments. By the addition of the individual-social category Weiss gives behaviorism a broader scope than does Watson, who confines behaviorism more to the physiology of behavior. But on the other hand, it cannot be said that Weiss has made any concessions to the older psychology in which the central aspect was emphasized. In reply to the criticism of Dr. H. C. Warren (**32**) that he is minimizing the importance of the central nervous system (for Warren regards memory, perception, imagination, etc., as adjustments of the central nervous system rather than responses) Dr. Weiss (**33**) replies that the categories of memory, thinking, etc., are behavior categories that include an individual-social aspect. Painting me your image means reproducing in me the stimulating conditions that will duplicate the neuromuscular conditions that you had when you saw the picture. The having of the motor pattern is the having of the image.

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In reply to the statement that he is underestimating the function of the central nervous system Dr. Weiss would say that the nervous system, and especially the brain, is simply a coördinating center for the integration of sensory and motor points so that they act in a harmonious manner. Just where a particular behavior pattern is localized in the brain is an evolutionary accident. The existing experimental evidence which indicates that functions more or less definitely localized in the cortex may shift their centers to adjacent areas substantiates the view that the brain is not an end in itself, but only a relay station on the way and entirely subordinate to the terminal system of responses.

Before proceeding to a more general criticism of the behavioristic account let us examine this view of Weiss's. The essence of the criticism of the present writer of the preceding view may be summed up in that statement that the category 'individual-social aspect' (through which the element of 'meaning' is smuggled into the system in connection with the use of the term 'signal') explains nothing. 'Individual-social aspect,' like the term 'gravitation' or 'instinct,' is not an explanation, but simply a name for the fact that under certain conditions certain things act in certain ways. This statement may be reinforced by the following additional observations.

Behaviorism regards organic behavior as a function of the changes in the environment. This environment, as physics and chemistry teach us, is a complex of relatively stable physical units of mass and energy. The internal changes in the organism are merely redistributions of the physical energic streams, released by the environmental impingments, along the most permeable pathways. We have already noted that the behaviorist does not tell us how he arrives at the external universe as a system of stereotyped physical units. Dr. Weiss would probably argue that an electron as a concept of science represents the external existence of a physical entity which physicists, as members of a social group, have labelled by a conventionalized individual-social category verbally known as the *electron*. Why the physicists should

regard their conventionalized reactions as 'truer' than the reactions of the Christian Scientists—since biologically they are on the same level—is an irrelevant question. The real problem is, *if reality is electrons and protons why should there be an individual-social aspect?* Let us restate this. An individual, for Weiss, is a relatively stable but extremely complex configuration of electrons and protons. Also, for behaviorists in general, he is nothing but the sum of his reactions to his environment. The unit, the organism, is only the totality of 'ultimate' units, differing from any other physical configuration by its quantitative complexity. *The 'reactions' or behavior patterns are included under the biophysical aspect because the biochemical properties of 'organic molecules' or 'protoplasmic systems' are its reactions.* In other words, in a strictly monistic ('materialistic') conception of evolution there is no difference between the 'reactions' of chemistry and the 'reactions' of biology, and there is no place where the 'individual-social' aspect can supervene upon the 'biophysical' aspect. Whatever categories Weiss has labelled 'social' must be deduced from the physiological complex—unless he believes in a 'group mind' or the organismic theory of society.[1]

Having now considered in a scrappy way the views of the individual behaviorists, we may bring this part of the subject to a termination by reinforcing the protest against the identification, by behaviorists in general, of thinking with implicit muscular response and imagery with kinæsthetic 'sensations' by submitting the following considerations.

Thinking goes on either as characterized by the absence of images or the presence of images. In the first case, that of imageless thought, it has not been proven that the central aspect is not the most important aspect, rather, the existing evidence is in the other direction. In the case where thinking goes on in terms of visual, auditory, or tactual images, the imagery is not necessarily kinæsthetic, although it sometimes

[1] Why the terms should originate which designate the categories of scientific thought is partly a problem for linguistics but whatever the origin of concepts and categories, it must be admitted that 'language behavior' originates in the reactions of individuals, and all reactions of the individual, for the behaviorist, are biophysical reactions.

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is. To illustrate: One finds his way around in a house in which the lights are extinguished by recalling where the objects are or ought to be. Orienting yourself, in this case, may go on largely in terms of muscular discriminations ('sensations') of movement, and this is the case when rats are learning to run a maze. Habit memory, as Bergson calls it in his 'Matter and Memory,' is motor memory. But where the mathematician thinks in terms of symbols it is hard to see what this means in terms of kinæsthesis. The behaviorists have never attempted to fit mathematical operations into their biological reaction system, though it is much in evidence in their conceptual reaction system. Mathematics is generally regarded as a science which has no content. Now if mathematical thinking is a muscular response, and a response is always to something, and this something (the 'stimulus') is always, as physics teaches, a 'physical thing,' then to what, for the behaviorist, is mathematics a response? and how must we redefine the 'content' of mathematics? Again, what is the difference, in terms of reactions, between Euclidian and non-Euclidian geometry, or physiological space and conceptual space? True, Watson's revised view of imagery as faint retinal stimulation does not permit us to identify the imagery of behaviorism with kinæsthesis, but to refute this modified view it is only necessary to point out that injury to the retina or the optic nerve does not carry with it destruction of visual imagery. Furthermore, the data given in introspection are not to be identified with any supplementary verbal reactions. The sensory content of introspection is there whether you tell anyone about it or not.

Nor is the idea and its verbal expression one and the same. We have the idea as a totality 'in mind' and we then proceed to analyze it out into words or written symbols, but the expression is not the idea as given introspectively. We frequently have ideas for which it is hard to find verbal expression, and the expression does not always coincide with the 'consciousness of meaning.' Dr. Lashley gets a different tracing every time a subject thinks over a given sentence. That is to say, "we can think the same word by many differ-

ent muscular combinations."[1] It is also known that diseases of muscle paralysis do not interfere with thinking. The reply to this (**34**) is the same as the answer to Sherrington's objection to the identification of emotion with the somatic reverberations, namely, that the response has been short-circuited so that the overt reaction drops out and the stimulus only needs to arouse the cerebral arc where the reaction, originally learned through the muscles, is now stored. The answer to this is that the behaviorist is obligated to show how this short-circuiting takes place. It is unfortunate that no experimental results are available to decide whether or not people suffering from various forms of muscle paralysis are capable of learning anything new.

The last objection to be urged against the behavioristic account of thinking rests upon Dr. Henry Head's study of 'Aphasia and Kindred Disorders of Speech' (**35**). A few quotations will suffice: "Evidently there must exist a group of functions indispensible for language in its widest sense, but not equally essential for all intellectual performance; . . . " (p 107). "It is obvious that this patient had not lost the power of reasoning and was in many ways highly intelligent. Although he was almost entirely deprived of speech and could not name anything placed before him, he could indicate the object or color named to him orally or in print, . . . " (p. 117). "It is not the 'general intellectual capacity' which is disturbed by these lesions of the brain, but the mechanism by which certain aspects of mental activity are brought into play" (p. 158).

This criticism of the behavioristic explanation of thinking and reasoning is not to be taken as a plea for a return to a dualistic psychology, with reason as the act of an agent called mind. It is an argument for the importance of the central nervous system, the phase of the receptor-adjustor-effector mechanism which some endocrinologists and behaviorists are apt to slight.

[1] I have seen this statement quoted several times but have never been able to find the original reference.

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Conclusion

The foregoing survey of the architecture of thought sets forth the structural and functional aspects of the process of reasoning. No attempt is made to present a solution to this most complicated problem of psychology. However, the prelude to any generally acceptable solution is that the disputants agree as to what is involved in, or what must be explained by, an adequate solution, and it is only by getting the logical, psychological, and physiological aspects of thinking before us that we can later discuss the situation with any degree of mutual understanding.

The only criticisms which are offered are presented to persuade the behaviorists that their explanation of thinking is much too simple, and that they are not 'conscious' of the extreme complexity of the whole problem. The writer holds that there is no hope of an immediate solution to the matter, if, indeed, a solution is desirable.

References

1. 'Principles of Mathematics,' by Bertrand Russell, p. 5.
2. 'Science et méthode,' H. Poincaré, p. 206.
3. *Propositional functions* are discussed in Whitehead and Russell's 'Principia Mathematica,' Vol. I, p. 15.
4. See Couturat's article in the 'Encyclopedia of the Philosophical Sciences,' Vol. I, p. 157.
5. For a discussion of the notion of *equality* see A. N. Whitehead's 'The Principle of Relativity,' Ch. III.
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INTROVERTS AND EXTROVERTS

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These two terms as applied to complementary types of personality have their origin with Jung, although he probably drew upon preceding writers in his formulations. He first presented the concepts in his 'Psychology of the Unconscious' and later elaborated his views in his 'Analytical Psychology.' Recently he has expanded his opinions on these types of personality to the scope of a volume (which will not be reported upon here). Since Jung's original contribution these concepts have been showered with attention, especially by writers of the psychoanalytic schools. Among those who have discussed the concepts at length, or who mention them in their writings, are Nicoll, Tansley, Hinkle, Kempf, White, Wells, Downey, McDougall, and Allport. The terms are increasing in vogue among laymen, and may often be encountered in non-technical articles. It becomes necessary, therefore, to examine closely the sense in which the terms are used, and to decide whether or not they are to be received into the fold of legitimate psychological categories.

Definitions of the Terms.—None of the writers seems to have attempted a concise definition of the two terms, each contenting himself with descriptions and explanations. The introvert, according to practically all of the writers, is characterized by a withdrawal from reality and a great emphasis on the thought processes, whereas in the extrovert we have the tendency to face reality and the ready issuance of thought processes into overt action. The reality which these writers infer, or to which they refer, is social reality or the social environment. The following definitions are probably fair composites of the various opinions.

Introvert: An individual in whom exists an exaggeration of the thought processes in relation to directly observable social behavior, with an accompanying tendency to withdraw from social contacts.

Extrovert: An individual in whom exists a diminution of the thought processes in relation to directly observable social behavior, with an accompanying tendency to make social contacts.

Descriptions of the Introvert and the Extrovert.—The most appropriate source for the description of the two types is Jung. He sees in the hysteric and the dementia præcox patient opposing types of reaction systems, characterized in the one instance by a centrifugal and in the other a centripetal tendency of the libido, or the individual's store of energy. These are pathological extremes of reaction systems that are found to a lesser extent in every normal person. We are all predominantly either introverted or extroverted. We say that a person tends to be extroverted "when he gives his fundamental interest to the outer or objective world, and attributes an all-important and essential value to it; he is introverted, on the contrary, when the objective world suffers a sort of depreciation, or want of consideration, for the sake of the exaltation of the individual himself, who then monopolizing all the interest, grows to believe no one but himself worthy of consideration" (**8**, p. 288).

The following extracts illustrate McDougall's treatment of the concepts.

"The well-marked extroverts are those whose emotions flow out easily into bodily expression and action. They are the vivid, vivacious, active persons who charm us by their ease and freedom of expression, their frankness, their quick sympathetic responses. They are little given to introspective brooding; they remain relatively ignorant of themselves; for they are essentially objective, they are interested directly and primarily in the outer world about them. When and if they break down under strain, their trouble takes on the hysteric type, the form of dissociations, paralyses, anesthesias, amnesias; in spite of which they may remain cheerful, active, and interested in the world.

The introvert, on the other hand, is slow and reserved in the expression of his emotions. He has difficulty in adequately expressing himself. His nervous and mental energies, instead of flowing out freely to meet and play upon the outer world, seem apt to turn inward, determining him to brooding, reflection, deliberation before action. And, when he is subject to strain, his energies are absorbed in internal conflicts; he becomes dead to the outer world, languid, absorbed, self-centered, and full of vague distress" (**10**, p. 85).

Nicoll goes into considerable detail in his interpretation of the two types. The following extract gives his attitude toward the problem of extroversion.

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"Extroversion to some people presents no difficulties. They come in contact with life eagerly, spontaneously, without preparation or plan. If they show any timidity at all, the slightest encouragement has an immense effect upon them. They are that large group of people who are sociable and who accept social values unquestioningly. They are fond of amusement and are not greatly burdened by the problems of this world. They flow out into action and into emotional contact very easily; they express sympathy, delight, sorrow, appreciation, disgust, indignation, and jealousy without any difficulty. There is plenty of emotional play about their facial expressions and gestures when they are talking. They love movement, bustle, and excitement, and respond to what is going on around them with great facility. Studied closely, it is possible to see that between their feelings and the expression of these feelings there is little or no barrier" (11, p. 139).

The secret of the character of the extrovert lies in the last sentence. He is no philosopher, arguing why and wherefore—he acts on the spur of the moment. As a consequence he is always getting into ticklish positions which the introvert by superior forethought would have avoided. This impulsiveness of action makes the extrovert throw himself into the heart of things as a coöperator, not as a spectator, especially on social occasions. Extroverts "have little self-knowledge from an analytical point of view. They know themselves by the effects they produce in the external world." For this reason we find extroverts often leading inconsistent lives, succeeding in spite of apparent but unconscious inconsistencies in their daily behavior which would trouble the conscience of an introvert.

The introvert, according to Nicoll, finds life continuously hostile. He is asocial—his interest turns persistently inward and away from contact with the world. His main problem is to find a means of extroversion, and unless he finds it he may live in a world of phantasy. The introvert prefers to read of a thing rather than experience it.

"The introvert type, in its most characteristic expression, is reserved, outwardly cold, guarded, watchful, and difficult to understand. Unlike the extrovert, who hides little, the introvert hides everything because he dreads the exposure of his emotions, because they are too raw and intense. They have not been worked up into useful feelings. . . . He reveals himself only to his most intimate friends, and then only in part. He is thoroughly aware of his inner life, and is a keen and serious critic of himself. His tendencies lie in the direction of self-depreciation, which he often counterbalances by an outer air of self-appreciation. His approach to everything is critical and suspicious. . . . Anxiety is a constant state of mind with him; he is anxious about the future and anxious about the present. Fear is the predominant factor behind his psychology, and this causes him, when in a position of responsibility, to leave nothing to chance. . . ." (11, p. 147).

Since the introvert knows himself better than the extrovert, he will be the more apt to feel the justice of accusations against him, which in the case of the extrovert would arouse a protest.

"To the introvert the extrovert is a source of amazement; while to the extrovert the introvert is an object of impatient speculation and uncertainty" (**11**, p. 149).

Allport defines the types as follows:

"The extroverted person is one whose mental images, thoughts, and problems find ready expression in overt behavior. Mental conflicts trouble him but little, and he appears to have nothing to repress or to avoid. The introvert, on the other hand, dwells largely in a realm of imagination, creating inwardly a more desirable ideal world rather than adjusting himself outwardly to the real one. He is not always a misfit, however, for given sufficient ability, his internal or covert reactions may be the vision of the poet or artist. On the whole he takes many things too personally, is anxious and self-searching, if not actually afraid of the repressions and conflicts which have not found a salutory neural outlet or resolution" (**1**, p. 12).

Kempf (**9**, p. 112) would say that introverts tend to be moody, self-conscious, irritable, eccentric, cautious and deliberative, and uncreative. They belong to the 'shut-in' type. "Fear of permitting the affect free play, such as in curiosity, friendliness, love seeking, prevents it from attaining practical contact with reality and the environment, and forces it to use endogenous forms of counterstimulation, as day-dreams, imaginations, hallucinations, etc." The extrovert, by inference, will possess the opposing characteristics.

Wells (**17**, p. 41) uses the term introversion to denote the avoidance of unpleasant external effort by seeking satisfactions within the self, in imagery and day-dreaming. Introversion is merely one of the ways in which unpleasant experiences are avoided.

Hinkle (**5**) adds little to these statements in a descriptive way, although she makes several important theoretical contributions. She accepts Jung's original formulation, but subdivides both introverts and extroverts into three groups; the objective, the simple, and the emotional or subjective. Objective introverts or extroverts "possess little or no differentiation of the subjective functions of feeling or intuition," whereas in the emotional introvert and the subjective extrovert the subjective or emotional factor is strong. Introverts and extroverts may be confused through the assump-

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tion by one of the types of the traits of the opposite type because of the prevailing family or national psychology. One type may assume the characteristics of the other type through unconscious identification, especially with an admired parent of the other type. This assumption cannot be maintained long without manifesting itself to the careful observer. Hinkle also identifies introversion with femininity (p. 130).

The writer has collected at times from several psychologists of standing and from graduate students in psychology, lists of what they considered the traits of the introvert and the extrovert. There is considerable agreement among the various contributors, which would point to a popular recognition and identification of the types were it not for the fact that these men had learned of the types from the same literary sources. The list is interesting in itself and is given below in condensed form. Only the traits of the introvert are given, since those of the extrovert would be merely the opposites of these. The descriptive terms apply to tendencies shown by introverts.

1. Blushes frequently; is self-conscious.
2. Avoids all occasions for talking before crowds; finds it difficult to express himself in public.
3. Prefers to work alone rather than with people; prefers to work at tasks that do not bring him into contact with people.
4. Dislikes and avoids any process of selling or persuading anyone to adopt a certain point of view (except in the religious field).
5. Takes up work which requires painstaking and delicate manipulation.
6. Hesitates in making decisions on ordinary questions that arise in the course of the day.
7. Introspects; turns his attention inward.
8. Depreciates his own abilities, but assumes an outward air of conceit.
9. Is critical of others.
10. Is extremely careful about the friends he makes; must know a person pretty thoroughly before he calls him a friend.
11. Limits his acquaintances to a select few. (This may be beyond his control.)
12. Has ups and downs in mood without apparent cause.
13. Has ups and downs in mood with apparent cause.
14. Works by fits and starts.
15. Worries over possible misfortunes.
16. Feels hurt readily; apparently sensitive about remarks or actions which have reference to himself.
17. Is outspoken; says what he considers the truth regardless of how others may take it.

18. Keeps in the background on social occasions; avoids leadership at social affairs and entertainments.
19. Is absent-minded.
20. Is reticent and retiring; does not talk spontaneously.
21. Shrinks when facing a crisis.
22. Prefers to work things out on his own hook; hesitates to accept or give aid.
23. Is meticulous; is extremely conservative about his dress and painstaking about his personal property.
24. Prefers participation in competitive intellectual amusements to athletic games.
25. Is a poor loser; considerably upset and indisposed after the loss of a competitive game.
26. Makes mistakes in judging the character and ability of others.
27. If he unburdens at all, he does so only to close personal friends and relatives.
28. Indulges in self-pity when things go wrong.
29. Day-dreams.
30. Limits his acquaintances to members of his own sex.
31. Is persistent in his beliefs and attitudes.
32. Shrinks from actions which demand initiative and 'nerve.'
33. Gets rattled easily; loses his head in excitement or moments of stress.
34. Expresses himself better in writing than in speech.
35. Is governed by reason rather than impulse or emotion. Is a good rationalizer.
36. Derives enjoyment from writing about himself.
37. Is thrifty and careful about making loans.
38. Is conscientious.
39. Resists discipline and orders.
40. Admires perfection of form in literature.
41. Is sentimental.
42. Rewrites his social letters before mailing them.
43. Pays serious attention to rumors.
44. Believes in 'mind' cures; accepts an idealistic philosophy.
45. Talks to himself.
46. Keeps a diary.
47. Is strongly motivated by praise.
48. Is selfish.
49. Is slow in movement.
50. Prefers to read of a thing rather than experience it.
51. Is suspicious of the motives of others.
52. Is effeminate (if a man).
53. Is a radical; wants to change the world instead of adjusting himself to it.
54. Is creative of new and sometimes eccentric ideas and things.

Theories of Introversion and Extroversion.—Few of the writers on the subject mention the causes of introversion and extroversion or the psychological theories which underlie the states.

Tansley gives a sketchy account of the theory of the introversion and extroversion. According to him,

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"the process of extroversion is the primitive biological function of the mind. Biologically the mind and its powers only have significance so far as they can be used in life. They were developed in relation to the world in which the organism lived and their nature was determined, as we have seen, by the environment of the species, to which they are intimately adapted. The process of introversion is primarily a sign of lack of such adaptation. For one reason or another the psychic energy of the mind fails to find its natural outlets, and being thus cut off from the external world it develops an internal world of its own. In the sequel, however, this internal development has proved of immense value in enriching human life by its secondary reactions with the external world" (13, p. 88).

Tansley also makes the contribution that the basic mind-structures on which the two types rest are probably inherited, and are easily recognized in childhood. A happy balance of the two tendencies in which lies the hope of a satisfactory mental development must be achieved in childhood. After adolescence the proper balance becomes much more difficult to attain, although his superior mental quality enables the introvert the more readily to acquire this balance. Hinkle also asserts that the types are born, not made.

McDougall, reasoning on the observation that children of the same parents are indifferently introverted or extroverted, concludes that the tendencies are inherited. The children are brought up in the same environment—therefore any temperamental differences which they display must be due to heredity. The opposite conclusions could be drawn from the same premises. It is questionable, furthermore, if all children of the same parents are brought up in the same environment. Families usually move about from one locality to another and their financial status does not remain fixed. The attitude of the family toward the youngest or oldest child may have an important influence in shaping his character.

Kempf would account for introversion at least in part by a predisposition to affective dissociation. By affective dissociation is meant in brief the following: The socialized interests of the individual are in constant conflict with self-indulgent affective cravings and in the main are dominant, but when the self-indulgent cravings are powerful and the socialized interests are weakened or depressed, the former will break through in the form of errors, forgetting, and undesirable thoughts. In complete affective dissociation the self-

indulgent cravings break through the resistance of the individual while he is not aware that they are doing so. Affective introversion takes place when an affective disturbance occurs but the prompt spontaneous response is inhibited and an outward appearance of indifference is maintained.

White prefers to think of introversion as a regression to an earlier way of thinking.

> "The introverted person is one who, instead of transferring his libido to external objects, receives, so to speak, these objects, or their effects, within himself and so he views the world from within, he considers the world according to the effect it has upon him. Taking our viewpoint from the external world, this is brought about by the process of what is called introjection or an entering into the individual of influences from without. . . .
>
> Introversion, at least when pathological, tends to bring about a retracing of the stages along which the psyche has come. . . . The viewpoint, it is believed, is a valuable one, but in its application the process of thinking should be kept in mind rather than the content of thought. The view maintained here is that in the introversion types of psychoses the patient reverts to ways of thinking that belong to earlier stages of development. . . .
>
> Introversion brings about a return to a less clearly defined individuality and a greater range of identification with the environment. Withdrawal from reality is a withdrawal from contact at higher levels but a return to a phylogenetically older and more diffuse form of contact" (18, p. 232–236).

This is to be contrasted with the quotation from Tansley cited above, to the effect that "the process of extroversion is the primitive biological function of the mind." Little can result from an atavistic interpretation of either of tne types. Except in their extreme form, both have their logical place in the modern social structure. The consensus seems to be that introversion and extroversion are the result of inherited predispositions. The extrovert is a calloused individual who makes a good impression on others and cares little what others say about him. The introvert, on the other hand, is readily rebuffed by his social environemnt, and in time develops an asocial 'set.' His sensitiveness steers him from society and he takes to philosophic, religious, artistic, or mechanical tasks. His ability in these lines may lead him to fame or to institutional care. The extrovert likewise may be either a social lion or a maniac.

None of the writers has mentioned the possibility of a glandular explanation of introversion and extroversion,

although it seems easy to trace an analogy between these types of personality and the functions of the thyroid, adrenal, or sex glands. They have also apparently overlooked the possibility that introversion may result in an individual who suffers from some physical defect of which he is constantly reminded in childhood; in a person who belongs to a despised minority; in a stranger in a foreign land; or in a petted or only child.

Examples of the Introvert and the Extrovert.—McDougall would say that the Mediterranean type (Latin Race) is essentially extroverted and that the Nordic type (Germanic Race) is introverted. Hinkle disagrees with this in calling England and the United States extroverted and Germany and France introverted nations. Kempf claims that Orientals are introverted. Nicoll informs us that among the extroverts are the great actresses, most of the great popular actors, all the great rhetoricians, and the majority of the great preachers; the great adventurers, the great bluffers, the great squanderers and humbugs, the people who seem to stand beyond the reach of reason and logic. Hinkle is more specific in calling Wilson an introvert and Roosevelt an extrovert.

To this we may add that the character types played by Douglas Fairbanks are usually broadly extroverted, and that the introverted trend is shown very decidedly in Strindberg's autobiographical novel, 'A Son of a Servant.'

Types of Personality Analogous to the Introvert and the Extrovert.—Jung supports his exposition by citing from writers on personality and character mention of opposing types which are analogous to the introvert and the extrovert. The first analogy is with James' distinction between the tender-minded and the tough-minded individual (**6**, ch. 1). The tender-minded person is rationalistic, intellectualistic, idealistic, optimistic, religious, free-willist, monistic, and dogmatical. The tough-minded person is an empiricist; sensationalistic, materialistic, pessimistic, irreligious, fatalistic, pluralistic, and sceptical. The tender-minded person corresponds to the introvert and the tough-minded to the extrovert.

A second analogy is with Ostwald's division of savants

and men of genius into classicists and romanticists (**12**, 11th Lecture). The classicists, in whom the introverted tendencies are easily identified, 'are slow to react, they produce with much difficulty, are little capable of teaching or of exercising direct personal influence, and lacking enthusiasm are paralyzed by their own severe criticism, living apart and absorbed in themselves, making scarcely any disciples, but producing works of finished perfection which often bring them posthumous fame' (**8**, p. 292). The romanticists, on the contrary, are quick and abundant in their production of projects and ideas, are excellent teachers, have much personal influence, and are possessed of a contagious enthusiasm and ardor.

Several other less important analogies are mentioned by Jung, but need not be summarized here. In the psychological literature, however, there exist numerous references to types which are somewhat similar to the introvert and the extrovert. One of the most important is the distinction which James makes between the explosive and the obstructed wills (**7**, Vol. 2. p. 537). The explosive will is described as native to a normal type of character 'in which impulses seem to discharge so promptly into movements that inhibitions get no time to arise.' Persons of this type are animated and talkative, and are possessed of great social abilities. Latins and Celts are most commonly apt to be of the explosive type. The persons of obstructed will exhibit the opposing characteristics. They are more given to thought, they inhibit their reactions in order to allow thought to take place, but carry it too far. They are at times given to day-dreaming. The introvert corresponds, of course, to the person of obstructed will, and the extrovert to the person of explosive will.

Distinctions similar to the one drawn by James are to be found in the writings of other psychologists. Watson (**15**, p. 332) distinguishes several different types of 'reactors.' The impulsive reactor is one who is plunged into action immediately by every stimulus. 'Thinking' does not occur at all or if it does occur, it comes too late to influence the act. The deliberative reactor is slow and at times fails to react. First

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one tendency and then another is predominant with the result that action is hindered or abolished. There is a balanced type in whom action always takes place after the competing tendencies have run their course.

Downey (**3**) has utilized James' distinction in classifying her tests of volitional and temperamental traits.

Baldwin (**2**) would classify people into two types, the sensory and the motor, basing his classification upon a preceding one by Ribot. The motor individual is prompt, quick, and unreflective,—he jumps to conclusions. He is dominated by habit and is very responsive to suggestion. The sensory individual is passive, contemplative, non-suggestible, withdrawn, and possesses physical inertia.

The writer (**4**) made a comparison of men who chose an occupation which brought them into contact with others and which demanded considerable social ability, with men who chose for their life work an occupation which demanded mechanical skill almost entirely. The differences between these two groups brought out by a long series of tests and questionnaires and a rating scale indicated that the group that we shall call the socially inclined excelled the mechanically inclined in excitability, self-confidence, open-heartedness, present-mindedness, good-nature, adaptability, talkativeness, neatness in dress, and quickness to make friends. The mechanically inclined were somewhat more self-conscious, conceited, and careful of details in their work, and were capable of making finer coördinations. The conclusions reached in this study were not that the two represented types, but rather that they represented the extremes of a normal distribution curve of mechanical-social inclination, most people showing very slight inclination in one direction or the other. More will be said of this concept of extremes later. The socially inclined group seems to be related to the extrovert and the mechanically inclined to the introvert.

Do Introverts and Extroverts Belong to Types? In spite of the strong criticism which the term 'types' has received at the hands of statisticians and psychologists, there is nothing to indicate that it will go out of use. It recurs frequently in

psychological literature and is a common word in conversation. If the existence of types could be proved it would be a great advance in psychology. The psychologist may certainly be envious when he compares his few ill-defined classifications of human beings with the more objective and complex classifications used by the zoologist. The difficulty, of course, lies in the fact that psychology is a subdivision of zoology and its data are more limited in range and therefore more difficult to classify. Its data are furthermore less tangible and stable than the data of sciences which are concerned with structure rather than behavior.

If we assume that types are characterized by having a certain amount of any one ability or combination of abilities, then we should expect each type to be differentiated from other types on the distribution curve of the ability or abilities in the general population. Each type would be represented by a mode in the distribution curve. Thorndike (**14**, Vol. 3, ch. 15 and 16) in a statistical discussion of types, shows that the distributions of single abilities or combinations of abilities are almost invariably unimodal, arguing for the existence of but one type—mediocrity. He says, furthermore: "It is very, very hard to find any case of a negative correlation between desirable mental functions. Divergence toward what we vaguely call better adaptation to the world in any respect seems to be positively related to better adaptation in all or nearly all respects" (**14**, vol. 3, p. 362). The most probable condition in any individual is one of mediocrity in most traits, with slight variations toward extremes in the remainder of the traits.

There is a sense in which the concept of types may be retained while still accepting the normal distribution of abilities, although the word 'extremes' should be substituted for 'types.' We may conceive of the distribution curve as attenuated by two opposing forces, and as a person is subject to one or the other of these influences he will score to one or the other side of the central tendency. If the forces do not act upon him or if they neutralize each other, he will score near the measure of central tendency. The two opposing

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forces may be called tendencies. The extreme individuals whom people tend to resemble may be described as those two persons whose scores in the ability or combination of abilities lie at the two remote extremes of the distribution curve of the general population. Or they may be conceived as hypothetical individuals who do not exist, or who lie at points on the distribution curve beyond the most remote point at which an individual has been known to score.

With some modification, this is the manner in which Weininger (**16**) views the absolute male and the absolute female and the intermediate manifestations in all human beings. All human beings tend to resemble the absolute male or the absolute female, but these are creations which have no actual existence. The tendency is determined by the relative strength of resemblance to the absolute male or female. Most people will show a slight tendency in one direction or another, and as the strength of the tendency becomes greater the frequency becomes less.

In some such sense as this lies the hope of harmonizing the concept of introvert and extrovert types with statistical facts. But there are other important theoretical matters which must be cleared up before the concepts can lay claim to a place in a scientific psychology. The writers must come to an agreement on the ability or constellation of abilities by which the extrovert-introvert opposition is identified. They must satisfy themselves that there are no other oppositions of personality extremes involving other combinations of traits, which may be fully as important as extrovert-introvert. Since the number of such oppositions is practically limitless, the thing may easily be reduced to absurdity. These matters of theory should be resolved in clear-cut terms and not in the verbiage of the psychoanalyst.

Following upon this is the problem of measuring the extent of the two tendencies in any individual. This reduces itself to the question: How may one differentiate between the extrovert and the introvert behavioristically? Apparent absorption in thought is not necessarily a criterion of introversion, unless the effects on overt behavior are studied.

Certainly we should find difficulty in learning anything accurate about this attitude of thinking from the individual himself, for other psychoanalytic mechanisms such as rationalization interfere to color any report which he may make. The distinction between the two types or extremes must rest basically upon readily identified abilities or traits.

The theory of introversion and extroversion has opened up an interesting field of speculation, but as yet it has failed almost wholly to attract the experimenter. To find a place in the body of psychological knowledge the theory must be expressed with less inconsistency and with more attention to experimental evidence. The field seems a promising one for the psychological investigator.

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DISCUSSION

HYPNOSIS IN THE SERVICE OF THE INSTRUCTOR

Hypnosis is often used for class demonstration and experimental purposes in courses in abnormal psychology. So many specific aspects of abnormal psychology may be quickly and concretely illustrated by means of hypnosis that a course would be very incomplete without actual experiments. In fact, it is historically correct to say that scientific abnormal psychology had its origin in experiments in hypnosis, for hypnosis makes possible the production under controlled laboratory conditions of abnormal mental processes such as occur in hallucinations, functional blindness, deafness, and paralysis, cutaneous anesthesia and hyperesthesia, and a host of other symptoms of the psychoneuroses. Especially significant in this connection is the work of Liébeault, Bernheim, and Charcot. The extent to which hypnotic phenomena may be profitably drawn upon in abnormal psychology is well illustrated by the contents of one of the best general introductory text-books in this field, Dr. Morton Prince's 'The Unconscious.' In a course which I give, with 'The Unconscious' as the chief text, I illustrate many of the points made by Dr. Prince by means of experiments not only in hypnosis but also in automatic writing and crystal gazing with profit, I am sure, to the class. Books intended for classroom use in certain fields of applied psychology also, sometimes make use of data regarding hypnosis. President Scott's 'Influencing Men in Business' is a good example of this, and to a less degree, his 'Psychology of Advertising.' The importance of suggestion in advertising, salesmanship, public speaking, and indeed in all fields in which the aim is to influence in any way whatsoever behavior and opinion, can be taught in no better way than through reference to hypnosis, in which suggestion operates in its most extreme degree. It is not often, however, so far as my own observation has extended, that actual experiments in hypnosis are performed in courses other than those in abnormal psychology.

There would seem to be many obvious advantages that might be gained through an extension of the practice of hypnosis by instructors not only in courses in applied psychology, but even in introductory courses in general psychology. First among these

advantages would be that of the increased interest which would be aroused among the students in the class. There is an unfortunate lack of interest shown in psychology by college students in many colleges in comparison, first, with the interest usually displayed in some other courses of study, as indicated by the enrollment in various departments, and second, with the interest that a concrete, scientific study of human behavior might be expected normally to create. How often one hears from students of elementary psychology the comment that the subject is 'dry'! All students really are interested in the science of human nature as it might be studied, but their interest is often killed in their first course both by the sort of traditional topics contained in many of the current text-books, and also by the manner of presentation of these topics both by the text-books and by the instructors. The inclusion in an introductory course of at least a few experiments in hypnosis to illustrate essential points would stimulate among the students a higher degree of interest than now generally exists.

A second advantage to be gained through including experiments in hypnosis in introductory courses in psychology would be the aid thereby given in proper instruction against spiritism and occultism in its various forms. Practically all American psychologists feel it their duty to question the claims of spiritism and of telepathy. But unless special pains are taken to obviate it, many students will remain skeptical if they accept hypnosis as a fact, and if, as is often the case, they classify it among occult phenomena involving telepathy. A denial by the instructor that there is anything in hypnosis which is not to be explained in behavioristic terms, if such denial is based merely upon description and theory, is much less effective than actual experiments with members of the class as subjects. And some of the students may easily and safely be taught to perform simple experiments in hypnosis, especially in light hypnosis. Two points can thereby be forcibly impressed upon the class: first, that practically all normal persons can be hypnotized, and second, that practically all normal persons can learn to hypnotize. Thus the normality of hypnosis and the absence of telepathy and animal magnetism in it can be brought home to all. To produce contractures and anesthesia in a subject by suggestion, and then to teach the subject to produce the same contractures and anesthesia by autosuggestion, is an excellent way of disabusing the popular mind or a class of students of the superstition that hypnosis involves in some way the direct domination of one will by another.

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Moreover, in terms of certain processes which hypnosis may be used to illustrate, an explanation of some aspects of the work of mediums can be made without any need of reference to occult explanations.

More important, however, than the above two general uses of hypnosis for educational purposes is a third and more specific use, namely, that of teaching more adequately and illustrating more clearly many common psychological facts. For example, the meaning of hallucinations can be illustrated quickly and forcibly by hypnosis. A mere definition of the term, with examples, is pedagogically ineffective in comparison with a single class demonstration. Specific use may be made of deep hypnosis in the general psychology class as an aid to instruction regarding sleep and the dream consciousness. The denial of dreamless sleep in those cases where there is no memory for dreams upon awakening may be shown to be possible in view of the complete amnesia that may follow a hypnotic trance crammed with vivid experiences. The solving of problems during sleep may be illustrated by hypnosis. Instructional use of hypnosis may be made in the discussion of one very important aspect of human motivation, namely, subconscious motivation, which can be illustrated briefly and strikingly through post-hypnotic suggestion. Post-hypnotic suggestion more than anything else, perhaps, except automatic writing, illustrates the nature of dissociation and of subconscious processes. A clear illustration of dissociation can be given in five minutes or less by producing in a subject in light, waking hypnosis, amnesia for his name, with the suggestion that his hand will write it automatically while the amnesia still persists. Another simple experiment, which can be done almost as quickly, showing the independent activity of dissociated processes in a greater degree than the experiment just referred to, is one in subconscious computation. In light hypnosis the subject may be given a problem in mental arithmetic, for which amnesia may be produced immediately, with the suggestion that his hand will write automatically the answer in five minutes, during which time the subject will be paying attention (consciously) only to the lecture or to the class discussion. Brief reference to functional diseases, such as hysterical blindness, deafness, aphonia, paralysis, etc., is justified in an introductory course in psychology, and these topics can be taught more effectively in a half-hour by means of an artificial temporary production of the diseases than in many hours without such illustration.

If some of these subjects are now outside the field of general psy-

chology as usually taught, this fact alone might suggest one reason why courses in general psychology are often unsatisfactory and unattractive to students. Such topics are among the most fundamental in the understanding of normal human behavior and consciousness. Especially in courses in general psychology that run through the whole college year there could easily be found a place for these subjects, and for the illustration of them through hypnosis. A present-day trend in the direction of broadening the scope of courses in general psychology is illustrated by a text-book recently published, Dr. C. R. Griffith's 'General Introduction to Psychology.'[1] This book contains one chapter on 'Hypnosis and the Subconscious,' and another on 'Psychology and Medicine,' which includes a further discussion of hypnosis. And Dr. B. C. Ewer's 'Applied Psychology'[2] illustrates a tendency to include in applied psychology more material of the sort which may be illustrated by hypnosis. In this book of less than 500 pages, practically 50 pages are devoted to the two chapters on 'Subconsciousness' and 'Suggestion,' and five chapters (more than 100 pages) deal with 'Mind and Health.'

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[1] Published by Macmillan, 1923.

[2] Published by Macmillan, 1923.

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EDITORIAL ANNOUNCEMENTS

We regret to announce the resignation of President James R. Angell as editor of the Psychological Monographs, which he has so successfully conducted for fourteen years. Dr. Shepherd Ivory Franz will undertake the editorship of the Monographs, resigning his position as editor of the Psychological Bulletin.

The Board of Editors of the Psychological Review Publications takes pleasure in announcing the election of Professor Samuel W. Fernberger, of the University of Pennsylvania, to take full charge of the Psychological Bulletin, beginning January 1, 1924.